SOUTH AFRICAN ASCIDIANS

By

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(With 60 figs)

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ABSTRACT

Tunicates are described from the shallow waters of South Africa from Saldanha Bay to Sodwana Bay, and include 22 new species. A list of ascidians previously recorded from this area is also presented with relevant comments. The new material represents only part of the fauna as few stations were investigated and many specimens could not be identified as they were single, immature or without larvae. A transition was found between the tropical KwaZulu-Natal area and the Eastern and Western Cape provinces, but no significant differences were noted between the western (Atlantic Ocean) and eastern (Indian Ocean) sides of the Cape. Cosmopolitan fouling species inhabit harbours.

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INTRODUCTION

Among the 82 species collected and described in this study, 22 are new to science. The order Aplousobranchia is dominant with 44 species, the order Phlebobranchia is represented by only eight species, and the order Stolidobranchia by 30 species. It is likely that these numbers greatly under-represent the ascidian fauna of South Africa, even when the 63 species previously described are included. Among the species recently collected, several were not mature and cannot be identified, but they do not belong with certainty to any already known taxa. Several species were collected by chance, hidden between other closely packed ascidians, often covered with sand.

Many of the newly collected ascidians represent new species, whereas previously described forms have not been found again. This can be easily explained. Both collections, recent and past, do not represent a systematic inventory of the South African fauna but were the result of occasional collections undertaken at distantly spaced stations. The ascidians described here were collected on hard substrata, either at low tide or by SCUBA diving. All previously described species were collected by dredging, often on soft bottoms, sometimes in deep water at 200–400 m on the Agulhas Bank far from the shore. Their collection was incidental to larger investigations undertaken during famous oceanographic expeditions, such as the *Valdivia*, *Challenger*, *Siboga* or *Deutsche Tiefsee* expeditions. Apart from this, the ascidians have never been the subject of a local study. Many of the species already described came from more northern locations along the African or Madagascan coasts, or from the southern or western parts of Australia, and very few from the Antarctic.

With such a miscellany of data, it is not possible to draw conclusions about the geographic distribution, or endemism rate of South African ascidians. Nevertheless, a boundary appears to exist between the warmer waters of the Indian Ocean and the Eastern and Western Cape provinces region, where tropical species have not been recorded. The opposite is less evident, and southern species have been encountered in KwaZulu-Natal and farther north, in Mozambique and Tanzania. Some species are common to the Atlantic and Pacific oceans. These are fouling species mainly encountered in harbours. Among them are *Cystodytes dellechiajei*, *Clavelina lepadiformis*, *Didemnum psammathodes*, *Diplosoma listerianum*, *Ciona intestinalis*, *Ascidiella aspersa*, *Botryllus schlosseri*, *Microcosmus squamiger*, *Styela canopus*, *Cnemidocarpa humilis*.

The algal bearing didemnids common to the Indo-Pacific region—*Didemnum molle*, *Lissoclinum bistratum*, and *Diplosoma virens*—penetrate KwaZulu-Natal.

MATERIAL AND METHODS

The ascidians were fixed and preserved in 4 per cent formalin in sea water. All identifications required dissection after removing the tunic. The organs were stained with hemalum and dehydrated in ethyl and butyl alcohols for mounting on microscope slides in a plastic medium. The China ink drawings were made with a camera lucida. The tunic spicules and spinules were observed with a scanning electron microscope Jeol 800. The type specimens of new species are registered in the South African Museum. The additional material is stored in the Museum National d'Histoire Naturelle Paris.

SYSTEMATICS

Family **Polyclinidae**

Aplidium circulatum (Hartmeyer, 1912)

Fig. 5

Amaroucium circulatum Hartmeyer, 1912: 349, pl. 39 (fig. 2), pl. 44 (fig. 6). Michaelsen, 1934: 130. Millar, 1955: 171; 1962: 122.

Material

One colony, Miller's Point, False Bay, Cape Peninsula, 8–12 m (Griffiths coll.).

Description

The colony has a hemispheric head on a conical peduncle narrowed at the base. The tunic is encrusted with sand in the peduncle and between the zooid systems. The oral siphons are arranged in circles around common cloacal apertures. The zooids can be easily seen through the pale tunic when the colony heads do not contain too much sand.

The zooids are very long, sometimes more than 15 mm (Fig. 5A). The six oral lobes have a straight margin or a median slit. The cloacal languet may be simple (Fig. 5D), but is more often divided into three unequal lobes (Fig. 5B, C); it originates from the dorsal edge of the siphon. The thorax is long with 11–14 rows of stigmata (Fig. 5B, C). The stomach is almost spherical with 25–28 longitudinal folds on tranverse sections, some of them interrupted (Fig. 5E). An oblique protruding fold is present on the post-stomach (Fig. 5B).

The post-abdomen is very long (Fig. 5A). The ovary is located far from the gut (Fig. 5B), followed by a double row of very numerous testis lobes reaching the heart (Fig. 5A).

Several larvae are brooded in the posterior part of the cloacal cavity (Fig. 5C). The trunk measures 0.75 mm. The ocellus and otolith are present. The three adhesive papillae are well separated between four odd triangular vesicles (Fig. 5F). In addition there are four round vesicles on each side and some on the dorsal side, and several irregular ones along the ventral line.

Remarks and distribution

These specimens correspond well to Hartmeyer's description and figures, and to the type specimen (ZMB 2769) from St Francis Bay, South Africa, but his colony was not mature. They also agree with Millar's (1955) sample from False Bay.

In 1962 Millar, following Michaelsen (1920*b*), hesitated concerning the possible synonymy with *Aplidium erythraeum* (Michaelsen, 1921) a species itself a synonym of *A. flavolineatum* (Sluiter, 1898*a*).

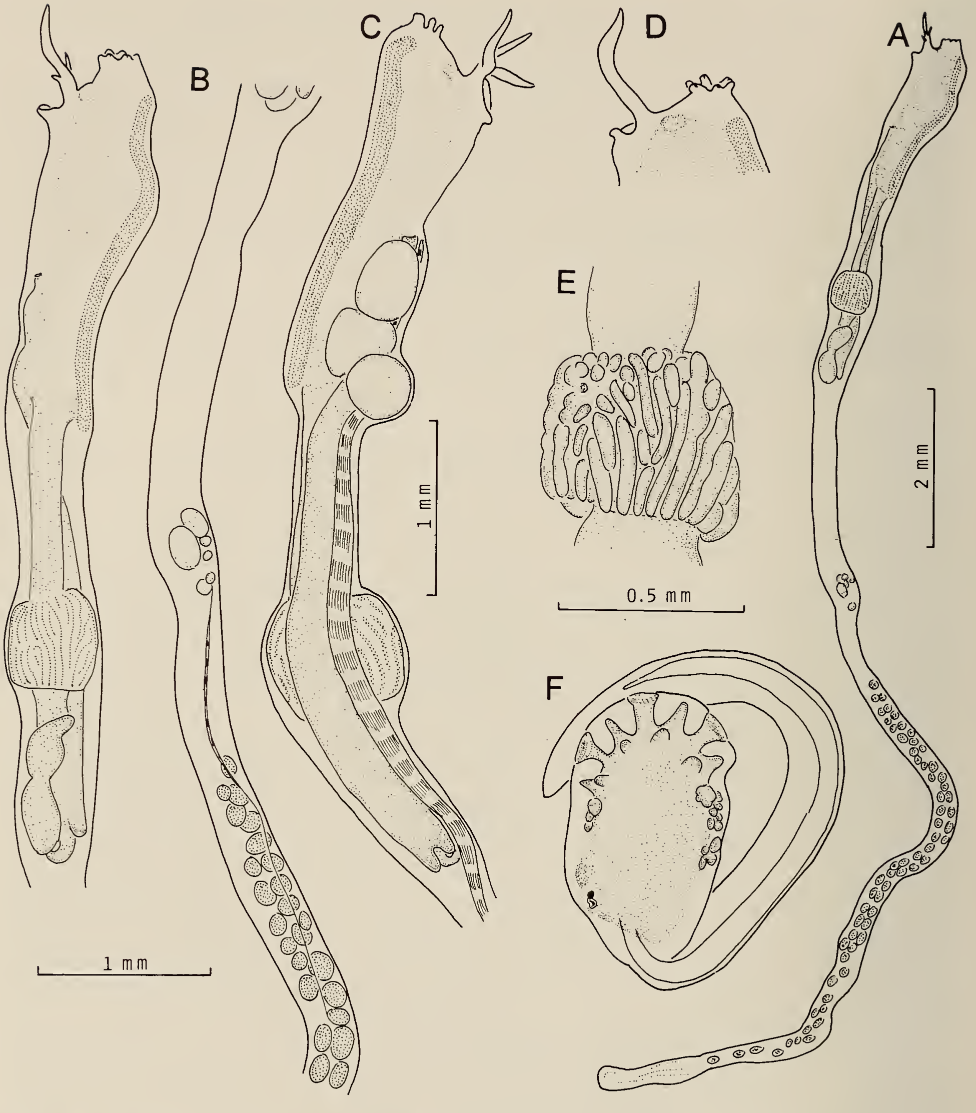

Fig. 5. *Aplidium circulatum.* A. Entire zooid. B. Thorax, abdomen and anterior part of the post-abdomen. C. Thorax and abdomen of a brooding zooid. D. Siphons of another zooid. E. Detail of the stomach. F. Larva.

Aplidium circulatum and *A. flavolineatum* are indeed very closely allied. They have in common circular systems, the same tunic consistency and shape of the zooids, the cloacal siphon in a short tube, and an average of 12 rows of stigmata. The differences are that *A. circulatum* has pedunculate colonies and different larvae of a larger size and with fewer anterior vesicles.

We have also not found in this species the dark pigment cells found in the zooid tissues of *A. flavolineatum*.

Aplidium crustatum F. Monniot sp. nov.

Fig. 6

Material

Holotype. SAM–A25841, Saldanha Bay (33°03'S 18°02'E), 1–2 m, collected by C. and F. Monniot, 8 February 1996.

Other material. Several colonies, Miller's Point (Cape Peninsula) and Saldanha Bay; intertidal (Monniot coll.).

Description

Colonies densely impregnated with sand to form irregular pads, about 10 mm thick, encrusting rocks at the interface with sand in the bottom of pools, or deeply embedded in rocky crevices. Their general consistency is hard and the

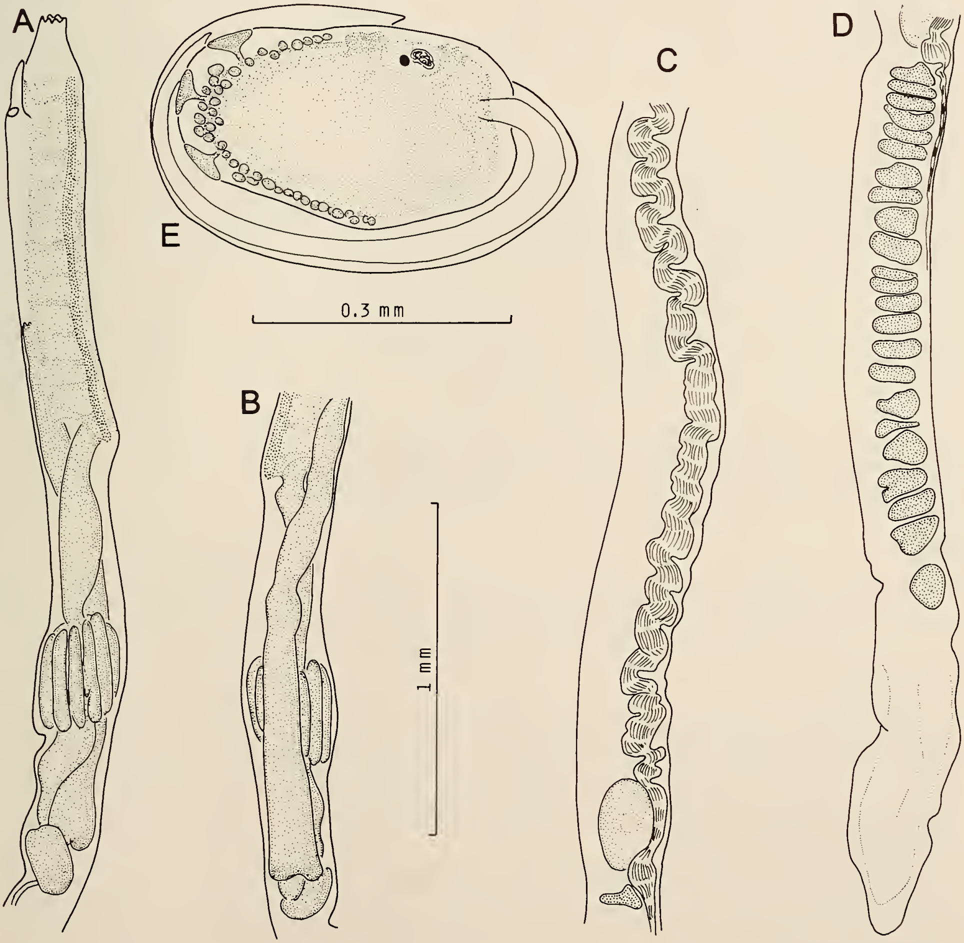

Fig. 6. *Aplidium crustatum* sp. nov. A. Thorax and abdomen. B. Other side of the same abdomen. C–D. Anterior and posterior part of the post-abdomen. E. Larva.

zooid openings cannot be seen among the sand grains. The colonies are tightly attached to the substratum and cannot be torn off without damage. Some colonies contain amphipods.

The zooids are particularly thin and elongated, with the post-abdomens crossing each other in all directions. The oral siphon is short and narrow with six pointed lobes (Fig. 6A). The cloacal siphon opens through a simple hole or short tube and is located in front of the first row of stigmata. Its dorsal edge is prolonged into a simple, stout, pointed languet (Fig. 6A). The thorax is narrow with 12 rows of a small number of stigmata. The abdomen is as long as the thorax and narrow (Fig. 6A, B). The stomach lies at mid-length of the gut loop and its wall has 10–14 folds (Fig. 6A). It is followed by the annular post-stomach. The anus opens at the level of the eighth row of stigmata. The post-abdomen is very long. The ovary is far behind the gut loop (Fig. 6C), at least at a distance equal to the abdomen length. The testicular vesicles are numerous, in a simple row extending from the ovary to the heart (Fig. 6D).

Three larvae mature in the cloacal cavity. They are small with a trunk 0.4 mm long. Their three anterior adhesive papillae are short and well separated with a continuous anterior crescent of small ampullae on each side (Fig. 6E).

Remarks

This species is characterized by colonies that are densely embedded with sand, have no definite shape, and thin zooids about 10 mm long, irregularly arranged, with a single line of testes.

Aplidium flavolineatum (Sluiter, 1898*a*)

Figs 1A, 7

Amaroucium flavolineatum Sluiter, 1898*a*: 30, pl. 1 (fig. 7), pl. 4 (fig. 12).
Aplidium flavolineatum: Millar, 1962: 120, fig. 2 (with synonymy).
non *Aplidium flavolineatum*: Monniot, F., 1987: 522, fig. 9F–I.

Material

Several colonies. From Saldanha Bay to Sodwana Bay, in rock pools and down to 9 m (Griffiths, Schleyer and Monniot coll.).

Description

The colonies form soft, thin, gelatinous crusts or cushions varying in colour: cream, pink, red or sometimes grey. The circular systems are always obvious. Each oral aperture is circled with a white line. Although there is no sand at the colony surface, there are often some sparse particles between the systems inside the colony.

The zooids are very variable in size, increasing with the size of the colony and linked to the length of the post-abdomen. The latter is elongate (Fig. 7A), the largest observed being 30 mm long. The oral siphon is wide with six large petal-like lobes (Fig. 7B). The cloacal siphon is anterior, in a short tube whose dorsal part is elongated as a long and simple languet, rarely with basal teeth

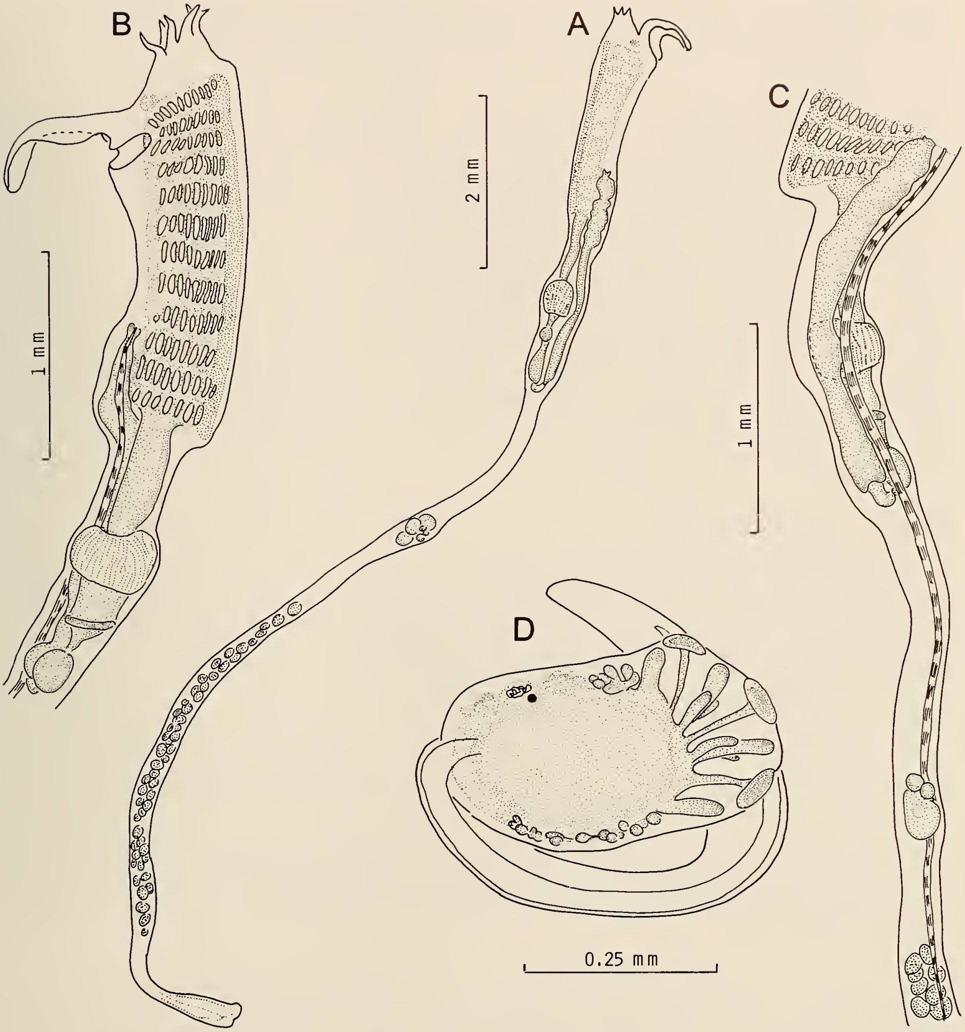

Fig. 7. *Aplidium flavolineatum*. A. Zooid. B. Details of the thorax and abdomen. C. Abdomen and ovary. D. Larva.

(Fig. 7B). Six long tentacles alternate with six smaller ones and a dozen buttons, located on a ring situated very high in the oral siphon. The thoracic muscles are essentially longitudinal with thin, regularly spaced fibres.

All tissues of many colonies contain dark, round pigment cells that may be dense or scarce, accumulated mostly in the thoracic body wall and branchial sinuses. The branchial sac has 10–12 rows of 12–15 stigmata, depending on zooid size (Fig. 7B). The dorsal line is not perforated and the dorsal languets are displaced to the left side in the posterior part of the thorax. The abdomen is approximately as long as the thorax. The oesophagus is long. The stomach is shorter dorsally than ventrally. Its wall has about 30 folds, some of them interrupted and oblique (Fig. 7B). The post-stomach is annular, followed by an oval mid-intestine. The rectum begins with caeca at the bottom of the gut loop (Fig. 7C) and remains isodiametric when empty until its aperture. The anus has two lobes.

The post-abdomen is extremely long. The ovary is far from the gut and at some distance from the testis (Fig. 7C). The double row of testicular vesicles occupies at least half the length of the post-abdomen, and reaches the heart. In a large zooid we counted more than 100 testicular vesicles (Fig. 7A).

Two or three embryos were maturing in the cloacal cavity, which is distended at their level, but the body wall does not protrude in a pouch. The larvae (Fig. 7D) have an oval trunk 0.5 mm long, an otolith and an ocellus. The three adhesive papillae are distally flattened into discs and have thin, long stems. They alternate with four long digitiform ampullae. There are two pairs of digitiform ampullae on each side of the median adhesive papillae. In addition, there are numerous dorsal and ventral round vesicles (Fig. 7D). The tail is coiled in a three-quarter turn.

Remarks and distribution

Aplidium flavolineatum differs from *A. circulatum* in colony shape, in having more numerous stomach folds, and in larval structure. Nevertheless, the uncertainty of several authors regarding the two species can be easily understood, as the colonies are variable. The synonymy with *Amaroucium erythraeum* after Michaelsen (1921) needs to be verified. The Chesterfield Islands (New Caledonia) specimens previously identified as *A. flavolineatum* by F. Monniot (1987) are very similar, but differ in having a protruding brood pouch. Kott (1992) re-identified the material as different species (*A. multilineatum*, *A. multiplicatum*, *A. gastrolineatum*, and *A. robustum*) specimens she had previously attributed to *A. flavolineatum*. Consequently, the known geographical distribution of *A. flavolineatum* remains limited to South Africa, from Saldanha Bay to Sodwana Bay. It is common intertidally along the whole south coast.

Aplidium haesitans F. Monniot sp. nov.

Fig. 8

Material

Holotype. SAM–A25842, Isipingo, KwaZulu-Natal (30°00'S 30°57'E), in rock pool, collected by C. L. Griffiths, 19 July 1994.

Description

A single colony 5 mm across, covered with sand, was attached to the underside of a colony of *Didemnum granulatum*. The soft tunic is glassy, perfectly transparent and does not contain sand. There is a common central cloacal aperture, but oral openings are not evident. The zooids are parallel with orange-red thoraces in formalin, fading progressively.

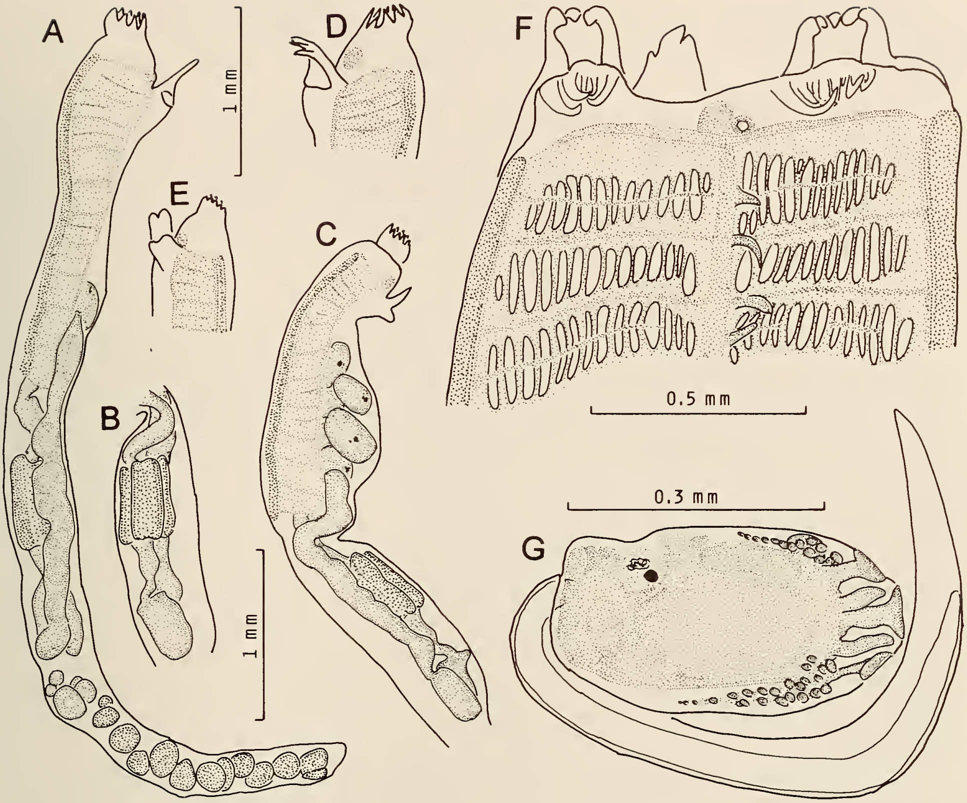

Fig. 8. *Aplidium haesitans* sp. nov. A. Entire zooid. B. Other side of the abdomen. C. Brooding zooid. D. Detail of the siphons. F. Anterior part of the branchial sac. G. Larva.

The zooids are thin and long. The cylindrical oral siphon has eight sharp lobes (Fig. 8D). The cloacal siphon is a narrow tube, its dorsal rim elongated as a stout short languet with a pointed (Fig. 8A), bilobed (Fig. 8E), or trilobed (Fig. 8D) tip. The longitudinal thoracic muscles are thin, number eight per side, and are regularly spaced. Thirty-two oral tentacles of three sizes are crowded against each other in a single ring. The branchial sac has 13 rows of stigmata in the most mature zooids, but fewer in others. Several rows are cut by a parastigmatic vessel (Fig. 8F) and some of them have divided stigmata. The rows of stigmata are interrupted along the dorsal line (Fig. 8F). On the left side, thin dorsal languets arise from the transverse vessels and smaller ones arise from the parastigmatic vessels (Fig. 8F).

The gut loop is as long as the thorax. The stomach is cylindrical with five longitudinal folds (Fig. 8B), followed by a narrow segment enlarged in a ring at middle length. The mid-intestine is wide. The rectum begins with caeca at the bottom of the gut loop. The anus opens far back in the thorax, at the third row of stigmata, above the oesophageal entrance (Fig. 8A).

The post-abdomen is longer in zooids with developed testis, shorter when the ovary has large oocytes. The ovary is anterior, just behind the abdomen (Fig. 8A), followed by a single row of testicular vesicles extending to the body extremity.

Up to nine embryos are incubated in the peribranchial cavity (Fig. 8C). The larval trunk measures 0.4 mm (Fig. 8G). Larvae possess an ocellus, an otolith and three adhesive papillae on long peduncles, separated by two odd, long conical ampullae. Numerous small round vesicles are accumulated dorsally and ventrally.

Remarks

A single colony of such small size with few but mature zooids may be an incompletely developed specimen. Nevertheless it contains many larvae, so the zooids have probably attained their final morphology. We hesitated before including this specimen in the genus *Aplidium* (thus the species name). Eight oral lobes occur in several genera of Polyclinidae and have limited specific diagnostic value. The cloacal siphon in a tube with a languet is also a character common to some species of *Aplidium*, *Ritterella* and *Synoicum*; *Synoicum* has a smooth-walled stomach. The difficulty is to decide, in so small a colony, whether the common cloacal aperture is the opening of a true common cloacal cavity or only a depression into which separate cloacal siphons open, as in some *Ritterella* species. Parastigmatic vessels are more common in the genus *Ritterella* than in *Aplidium*, but in the genus *Aplidium* the number of rows of stigmata is generally higher. The larval structure could correspond to one or the other genus.

The presence of eight oral lobes, 13 or more rows of stigmata with parastigmatic vessels, five stomach folds, and a larva with two odd ampullae between the three adhesive papillae excludes all already described species of *Aplidium* or *Ritterella*. The presence of a small common cloacal aperture persuades us finally to place this new species into the genus *Aplidium*.

Aplidium mernooensis (Brewin, 1956)

Figs 1B, 9

Amaroucium mernooensis Brewin, 1956: 132, fig. 4A.
Aplidium mernooensis: Millar, 1982: 22, fig. 8. Monniot, F., 1987: 528, fig. 11H, K.
Aplidium filiforme Kott, 1992: 542, fig. 75.

Material

Two colonies. Sodwana Bay, KwaZulu-Natal, 14–28 m (Schleyer coll.).

Description

The colonies are densely impregnated with sand and consist of lobed masses of spherical outline. The zooids are located in circular systems around very small central cloacal apertures. The zooid thoraces are red in life but yellow in formalin; the abdomens are colourless in a colourless tunic. Some lobes of the

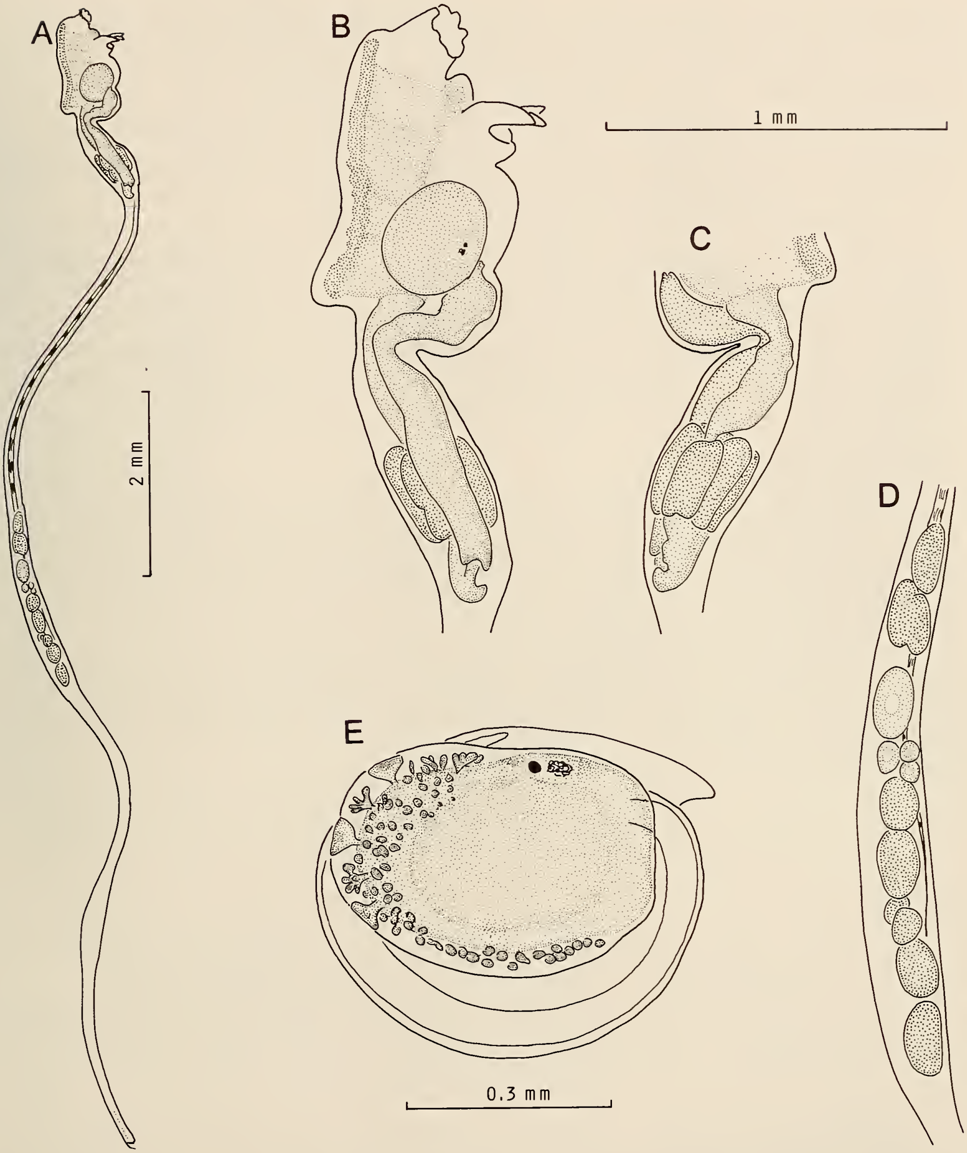

Fig. 9. *Aplidium mernooensis*. A. Zooid. B. Thorax and abdomen of a brooding zooid. C. Other side of the abdomen. D. Gonads. E. Larva.

colonies consist of only one system, but most often the lobes are grouped in large common masses.

The zooids are thin and long (Fig. 9A). The oral siphon has eight small lobes (Fig. 9B). The narrow cloacal siphon is prolonged by a trifid languet that extends its upper rim (Fig. 9B). The longitudinal thoracic musculature is made up of 7–8 muscles on each side, issuing from the oral siphon, and 4–6 muscles coming from the cloacal siphon. The branchial sac has five rows (Fig. 9B) of 12–13 stigmata on each side. The abdomen is narrower than the thorax. The stomach wall has five deep folds (Fig. 9C), the mid-intestine is olive-shaped and the rectum begins with caeca (Fig. 9B). The post-abdomen is long, even when it does not contain gonads. The ovary is far from the gut, half way along the post-abdomen. Few testicular vesicles occur in a single row before and behind the ovary (Fig. 9D), but do not reach the cardiac extremity.

Two to three larvae are incubated in the peribranchial cavity. They are small with an average trunk length of 0.5 mm. They have three well-spaced anterior adhesive papillae, between each of which is a branched protuberance of bunched, small vesicles. Numerous small additional vesicles extend in an anterior crescent on each side of the papillae (Fig. 9E). The median vesicles between the papillae only appear at an advanced stage of the larva. They are also present in the material from New Caledonia (Brewin 1956).

Remarks and distribution

All characteristics correspond well to the Brewin's (1956) type specimen from Chatham Rise, to the material described by Millar (1982) from New Zealand, and to the specimens from New Caledonia (Monniot, F. 1987). The only difference is that the present colony is more massive and most of the lobes consist of several systems.

The species *Aplidium filiforme* Kott, 1992, comprising specimens from Western Australia and Queensland, perfectly corresponds to the South African specimens, and only differs from the type in that the colony lobes are made of several systems. We consider it a synonym.

***Aplidium monile* F. Monniot sp. nov.**

Fig. 10

Material

Holotype. SAM–A25843, Thompson's Pool, near Ballito (29°31'S 31°13'E), KwaZulu-Natal, collected by C. L. Griffiths, 11 July 1994.

Other material. Several specimens, Sodwana Bay, KwaZulu-Natal, intertidal (Schleyer coll.).

Description

Several cushion-shaped colonies were collected, the largest being 30 mm in diameter; they are of variable thickness, up to 10 mm. They are very soft and pink with paler apertures arranged in irregular double rows, giving a botryllid appearance. The common cloacal openings are simple holes. No sand is embedded in the colony but some sediment is stuck to the sides and the basal layer of the pads.

The zooids have a red thorax in life. In formalin, the colour fades progressively, leaving only four red spots at the base of the oral siphon, sometimes linked in pairs by a red line. The other tissues turn yellow and later become colourless. The zooids are perpendicular to the colony surface. The six oral lobes are large but the siphon itself is short (Fig. 10A). The cloacal opening

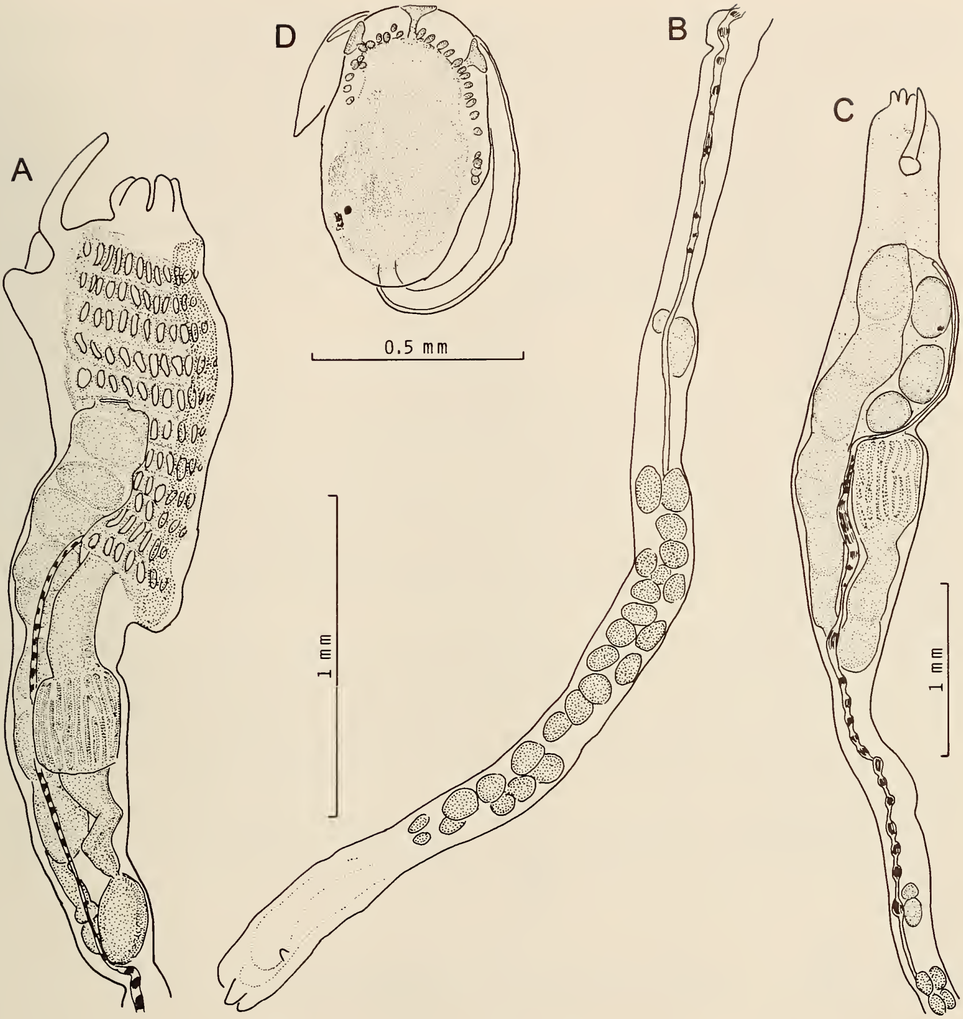

Fig. 10. *Aplidium monile* sp. nov. A. Thorax. B. Post-abdomen. C. Thorax and abdomen of a brooding zooid. D. Larva.

faces the first row of stigmata. Its upper rim has a simple pointed languet (Fig. 10A), sometimes with two small lateral lobes. The thoracic muscles are mostly longitudinal with thin fibres. The branchial sac has 10–11 rows of stigmata (Fig. 10A) that are not interrupted on the dorsal line.

The abdomen is about the same length as the thorax. The posterior side of the stomach is half way along the gut loop. There are 18–20 longitudinal folds in a transverse section, some of which are cut or interrupted (Fig. 10A, C). The post-stomach has the usual annular swelling (Fig. 10A). The olive-shaped mid-intestine is separated from the rectal caeca by a constriction. The anus has two lobes and is mid-way along the thorax. The pyloric duct enters the stomach in the middle of its side. The post-abdomen may be very long. The ovary is far from the gut loop (Fig. 10B), and is followed by a double row of testis vesicles that occupy the posterior half of the post-abdomen to the heart (Fig. 10B).

The larvae are brooded inside the peribranchial cavity, rather posteriorly (Fig. 10C). They often protrude on the dorsal side of the thorax. We observed a maximum of five in any zooid. The larvae (Fig. 10D) have a trunk 0.6 mm in length. The tail encircles three-quarters of the trunk. The sensory vesicle is located rather far back. The three adhesive papillae are short. A half ring of round vesicles on each side of the anterior side is reminiscent of a pearl necklace (Fig. 10D), giving this ascidian its specific name. There are no median ampullae between the adhesive papillae.

Remarks

This species nearly fits the description given by Kott (1992) for what she named *Aplidium altarium* (Sluiter, 1909). However, the type specimen from Indonesia (ZMA TU 176) has conspicuously different larvae and a short post-abdomen. Millar's (1956) description of samples from Mozambique, identified as *A. altarium*, corresponds better to the type of *A. altarium* with regard to the larvae, but the post-abdomen is in a resting state and the colonies are very small. The distance between these localities increases the doubt about the species identification.

Aplidium monile sp. nov. has many characteristics in common with *Aplidium rosarium* Kott, 1992, from Queensland; both are gelatinous colonies and the zooids have 12 rows of stigmata and 20 stomach folds. The gonads of *A. rosarium* are not described. Its larvae also have a half-ring of vesicles on each side of the adhesive papillae, but differ in having median ampullae between the papillae.

Aplidium monile differs from *A. flavolineatum* in the shape of the zooid systems (which are not circular), the number of stomach folds and the larval structure.

Aplidiopsis tubiferus **F. Monniot sp. nov.**

Figs 1C, 11A–C

Material

Holotype. MNHN A1 APL.A 16, Ibo Island, Mozambique, 10 m, collected by Monniot, 1995.

Other material. One colony, Sodwana Bay, KwaZulu-Natal, 21 m (Schleyer coll.).

Description

The colonies form balls, the largest collected being 25 mm in diameter, supported by a wide cylindrical stalk 15 mm high. The colour is tan due to sparse clear sand grains adhering to the colony surface mixed with the dark purple colour of the tunic. The colonies turn orange in formalin. Sand is totally absent inside the tunic, which has a tough surface layer, but soft internally between the zooids.

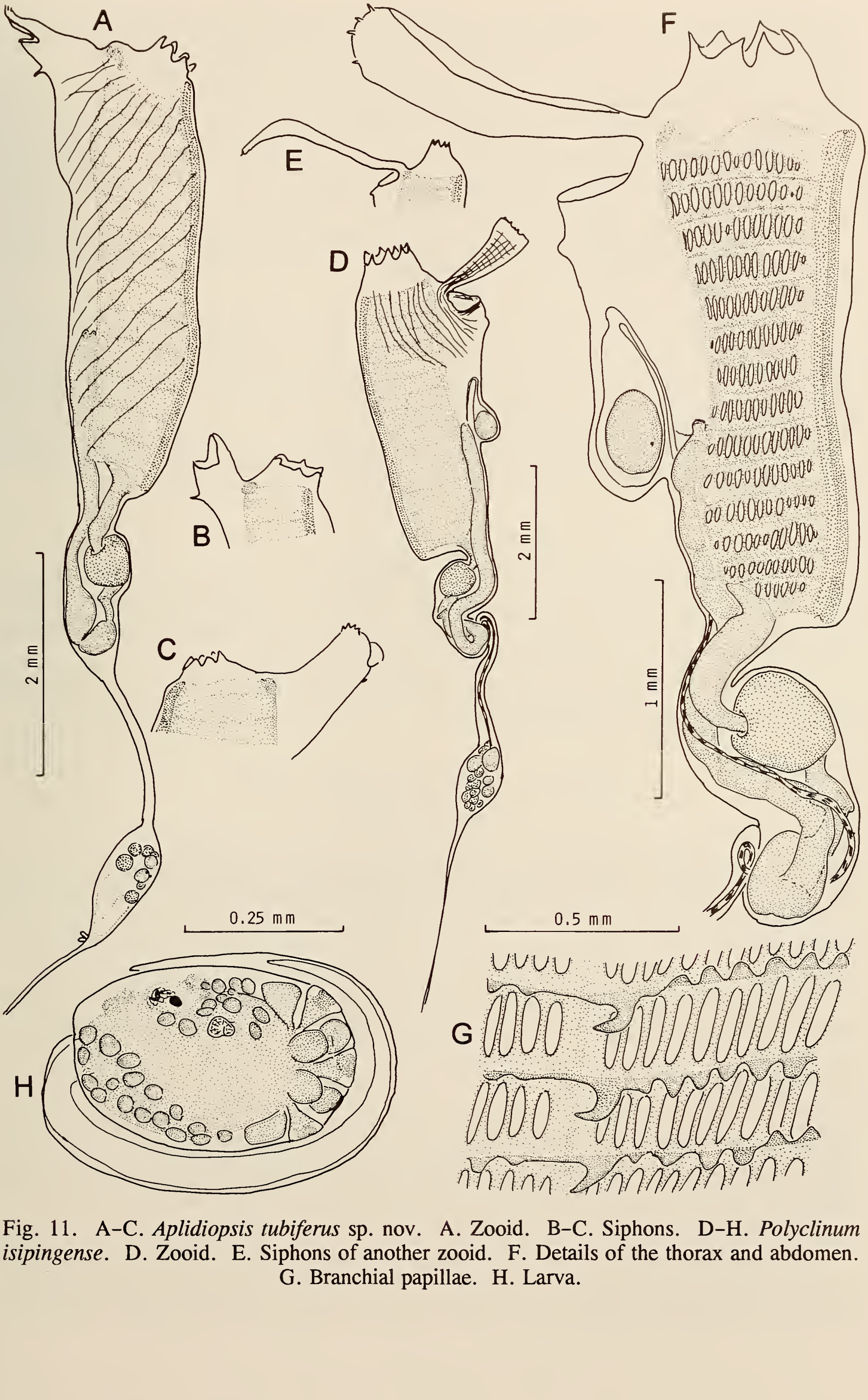

Fig. 11. A–C. *Aplidiopsis tubiferus* sp. nov. A. Zooid. B–C. Siphons. D–H. *Polyclinum isipingense*. D. Zooid. E. Siphons of another zooid. F. Details of the thorax and abdomen. G. Branchial papillae. H. Larva.

The zooids are perpendicular to the colony surface, and are arranged in circles around common cloacal apertures. In formalin their colour is orange. The oral siphon is short with six lobes (Fig. 11B, C). The cloacal siphon forms a long tube (Fig. 11B, C) and the dorsal margin can be elongated into a short, wide languet with teeth on the anterior edge (Fig. 11A). A papilla protrudes dorsally below the cloacal siphon (Fig. 11A–C). The thoracic muscles are oblique within the thin, transparent body wall (Fig. 11A). The oral tentacles alternate in three orders of size. The branchial sac contains 12–13 rows of 14–18 stigmata on each side (Fig. 11A). An unperforated area is located on each side of the endostyle. The rapheal languets are long and wide. There are no papillae along the transverse vessels.

The abdomen is clearly shorter than the thorax and the spherical, smooth-walled stomach is located in its middle (Fig. 11A). The gut loop is not twisted. The post-abdomen is inflated by the gonads and the heart, and linked to the abdomen by a long, thin, straight peduncle. No larvae were present in the colonies from South Africa or Mozambique.

This species is characterized by its long, tubular cloacal siphon (from which the specific name is derived) and the long, narrow, post-abdominal peduncle.

Remarks

The shape of the colony of *A. tubiferus* resembles the Tasmanian *A. confluata* Kott, 1992, and the Southern Australian *A. mammillata* Kott, 1992. However, these differ in having the cloacal languet inserted above the siphon, more stigmata rows, and zooids arranged in double rows.

Aplidiopsis pyriformis (Herdman, 1886) from Kerguelen has a shorter post-abdomen and more rows of stigmata.

Polyclinum isipingense Sluiter, 1898

Figs 1D, 11D–H

Polyclinum isipingense Sluiter, 1898*a*: 21, pl. 2 (fig. 1), pl. 4 (fig. 3). Millar, 1962: 136, fig. 10, synonymy. Plante & Vasseur, 1966: 144, pl. 1 (fig. 4). Monniot & Monniot, 1976: 358.

Material

Several colonies. Isipingo, KwaZulu-Natal, rock pools (Griffiths coll.); Saldanha Bay and Miller's Point, False Bay, low tide (Monniot coll.).

Description

The colonies form large cushions, the largest collected being 50 mm in diameter. They are covered with sand but there are far fewer particles inside the tunic. The colour is dark green or brown. The common cloacal apertures are raised in short chimneys above the colony surface. The zooids are arranged in circular systems. The tunic is transparent and soft but resistant.

The six oral lobes are pointed. The cloacal siphon has a long languet ending in a sharp thin tip or several teeth on a straight margin (Fig. 11D, F). There is a small papilla on the dorsal body wall behind the cloacal siphon (Fig. 11D, F).

The muscles are restricted to the anterior part of the thoracic wall (Fig. 11D). The branchial sac (Fig. 11F) contains 11–15 stigmata rows, a number which varies with zooid and colony growth. The papillae on the transverse vessels are about as numerous as the stigmata (Fig. 11G). The abdomen has the usual shape in the genus. The post-abdomen hangs on a long thin peduncle (Fig. 11D). The ovary lies in the centre of a cluster of testis vesicles. The larvae are incubated within the oviduct in the cloacal cavity (Fig. 11F). The trunk is 0.5 mm long (Fig. 11H). The three adhesive papillae are separated by two vesicles, and four ampullae are present on each side. There are also a dorsal and ventral series of vesicles. One or several calcium oxalate crystals are found in the visceral mass.

Remarks and distribution

The species is well characterized by the shape of the colony and the raised common cloacal apertures above circular systems of zooids. Its known distribution extends from Madagascar (Plante & Vasseur 1966) and Mozambique (Monniot & Monniot 1976) to the Western Cape Province. It differs from *P. neptunium* Hartmeyer, 1912, in its larval structure.

Pseudodistoma africanum Millar, 1954

Figs 1E, 12A–D

Pseudodistoma africanum Millar, 1954: 128, fig. 1; 1962: 138, fig. 12.

Material

Several colonies. Sodwana Bay, KwaZulu-Natal, 24–34.5 m (Schleyer coll.).

Description

All colonies are equivalent in shape, and correspond to that of the type specimen in the British Museum. They consist of one to several stalked lobes, each with a sandy peduncle and a wider conical head containing the thoracic and abdominal parts of the zooids. The tunic around the siphons has no sand but some particles are embedded deeper between the zooids. The colour of the colonies varies from white (rarely) or pink to a deep orange-red. The colour is partly due to the tunic, but mostly to the zooids in which the thoraces are deeply pigmented. In formalin the pigment becomes yellow and later disappears.

The zooids (Fig. 12A) are immature in all colonies. The thorax is short (Fig. 12B). The siphons are also short and have six lobes. There are at least 30 stigmata per half row. The gut forms a simple loop. The stomach, at the mid-length of the abdomen, is square in cross section, giving it longitudinal crests when contracted. The base of the rectum is enlarged. The post-abdomen is extremely long. The gonads were not developed, and no larvae were found.

Remarks and distribution

In spite of the absence of gonads and larvae, the colonies and zooids were characteristic enough to identify the species by comparison with the Millar cotypes from the British Museum. The distribution of *P. africanum* is presently restricted to South Africa.

Pseudodistoma delicatum F. Monniot sp. nov.

Figs 1F, 12E–G

Material

Holotype. SAM–A25844, Sodwana Bay (27°33'S 32°42'E), KwaZulu-Natal, 24 m; collected by M. Schleyer, 8 November 1994.

Other material. Several colonies from Sodwana Bay (Schleyer coll.).

Description

The colonies form a soft encrustation on polychaete tubes which are over 100 mm in length. They are folded back on themselves when they extend beyond the support of the tubes. The colony thickness varies from 5 to 10 mm when fixed. In life, the colour is bright orange with transparent red siphons slightly raised above the surface. The colour disappears when fixed, and the tunic becomes perfectly transparent. There is no embedded sand. The zooids are arranged in sinuous lines, with their siphons placed one behind the other. The general consistency is soft, but the tunic is resistant.

The short zooids (Fig. 12E, F) are only 5–6 mm in length when partially contracted. Both siphons are short and have six round lobes. There is a pigment spot on the neural ganglion. The tentacles are numerous and short, in three orders of size in three circles at the base of the oral siphon. There is a large unperforated area before the branchial sac. The first row of stigmata is dorsally curved (Fig. 12F) with 22–24 perforations on each side. The waist between the thorax and abdomen is circled by a belt of pigmented tunic. The abdomen is short, with a smooth-walled stomach in the middle (Fig. 12F). The rectum begins with the usual caeca (Fig. 12E, F).

The post-abdomen length depends on the gonad development. It is generally short and may be much reduced when the testis vesicles regress and the ovary develops. In the male phase, there is a cluster of about 25 round testis vesicles that does not reach the heart. When the ovary develops, it grows close to the gut and against the testis, so that the male vesicles gather in the anterior part of the post-abdomen, swelling it and giving the post-abdomen a triangular shape (Fig. 12E, F). The post-abdomen terminates in several vascular appendages (Fig. 12E, F).

The larvae (Fig. 12G) measure 0.75 mm in length in trunk, with a tail in three-quarters of a turn around it. They are incubated, one at a time, in an extremely distended dilation of the thoracic body wall which has no peduncle (Fig. 12E, F). In mature larvae three rows of stigmata are open (Fig. 12G). The ocellus and the otolith are present. The three anterior papillae are very wide, forming large cups that are crowded together to form a compact mass separated from the visceral mass by a constriction. No vesicles or ampullae were observed.

Remarks

This species is clearly distinct from *P. africanum* by the colony shape and consistency, the absence of embedded sediment, and the shorter post-abdomen.

Pseudodistoma delicatum differs from *P. fragile* Tokioka, 1958, in the colour of the colonies, the less brittle consistency of the tunic, and, mostly, in the size and anatomy of the larvae.

Ritterella solida **F. Monniot sp. nov.**

Figs 1G, 13A, B

Material

Holotype. SAM–A25845, Oudekraal, Cape Peninsula (33°59'S 18°21'E), 10 m; collected by C. L. Griffiths, 18 August 1994.

Etymology

The specific name refers to the particularly solid and massive colony.

Description

The large, ridged and folded colony is white in life, 45 mm thick, tough, impregnated with sediment but with little sand at the surface. The zooid apertures do not manifest any regular arrangement. When fixed, the colony turns brown.

The zooids are slender (Fig. 13A) and perpendicular to the colony surface. Both siphons are closely spaced, cylindrical and of equal size with six sharp lobes (Fig. 13B). The siphons are orange in life. The cloacal siphon is closed by a velum. There are 16 tentacles in three orders of size. The thoracic musculature is weak. The branchial sac (Fig. 13B) has nine rows of stigmata with an average of 14–15 stigmata on each side. There are no parastigmatic vessels nor are there papillae on the transverse vessels.

The abdomen is slightly shorter than the thorax. The stomach is as wide as it is long and has five deep longitudinal folds (Fig. 13B). The gut loop is very narrow. The rectum begins with two caeca at some distance from the bottom of the loop. The anus opens in the middle of the thorax through two large lobes.

The post-abdomen is long (Fig. 13A). The gonads are poorly developed in the single colony studied. The ovary is far behind the abdomen (Fig. 13A). The testis vesicles are in two rows and occupy the second half of the abdomen but do not reach the heart at this stage.

The colony does not contain embryos or larvae.

Remarks

Of the species of the genus *Ritterella* that have about ten rows of stigmata, many have colonies made of pedunculate lobes: *R. cornuta* Kott, 1992; *R. multistigma* Kott, 1992; *R. pulchra* (Ritter, 1901); and *R. tokiokai* Kott, 1992. Among the massive colonies only two deep-sea species have stigmata rows approaching these in number: *R. mirifica* Monniot, C. & Monniot, F., 1983, and *R. rete* Monniot, C. & Monniot F., 1991. They are very different from *Ritterella solida* sp. nov.

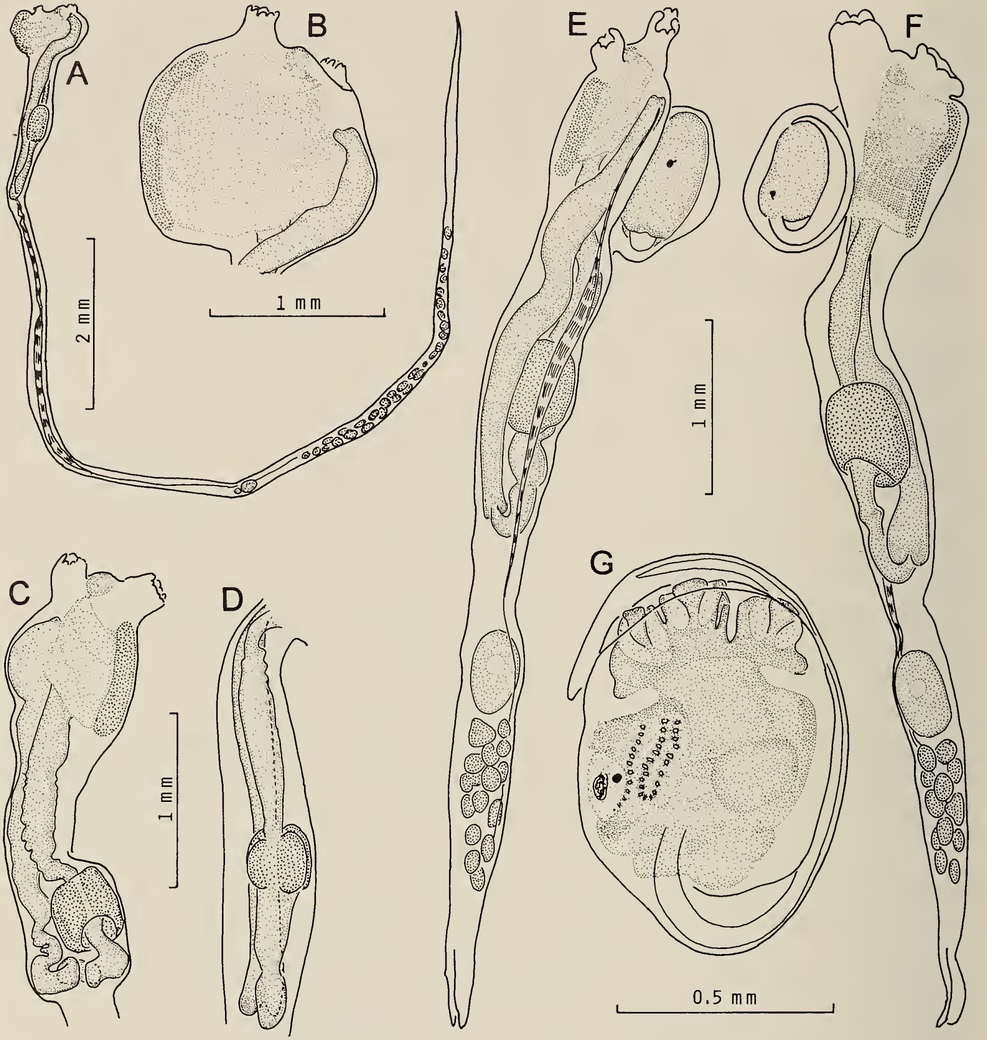

Fig. 12. A–D. *Pseudodistoma africanum*. A. Zooid. B. Detail of the thorax. C. Thorax and abdomen of another zooid. D. Abdomen of a zooid from the type colony. E–G. *Pseudodistoma delicatum* sp. nov. E–F. Two zooids. G. Larva.

Euherdmania divida **F. Monniot sp. nov.**

Figs 1H, 13C–E

Material

Holotype. SAM–A25846, Isipingo, KwaZulu-Natal (30°00'S 30°57'E), in rock pools; collected by C. L. Griffiths, 10 July 1994.

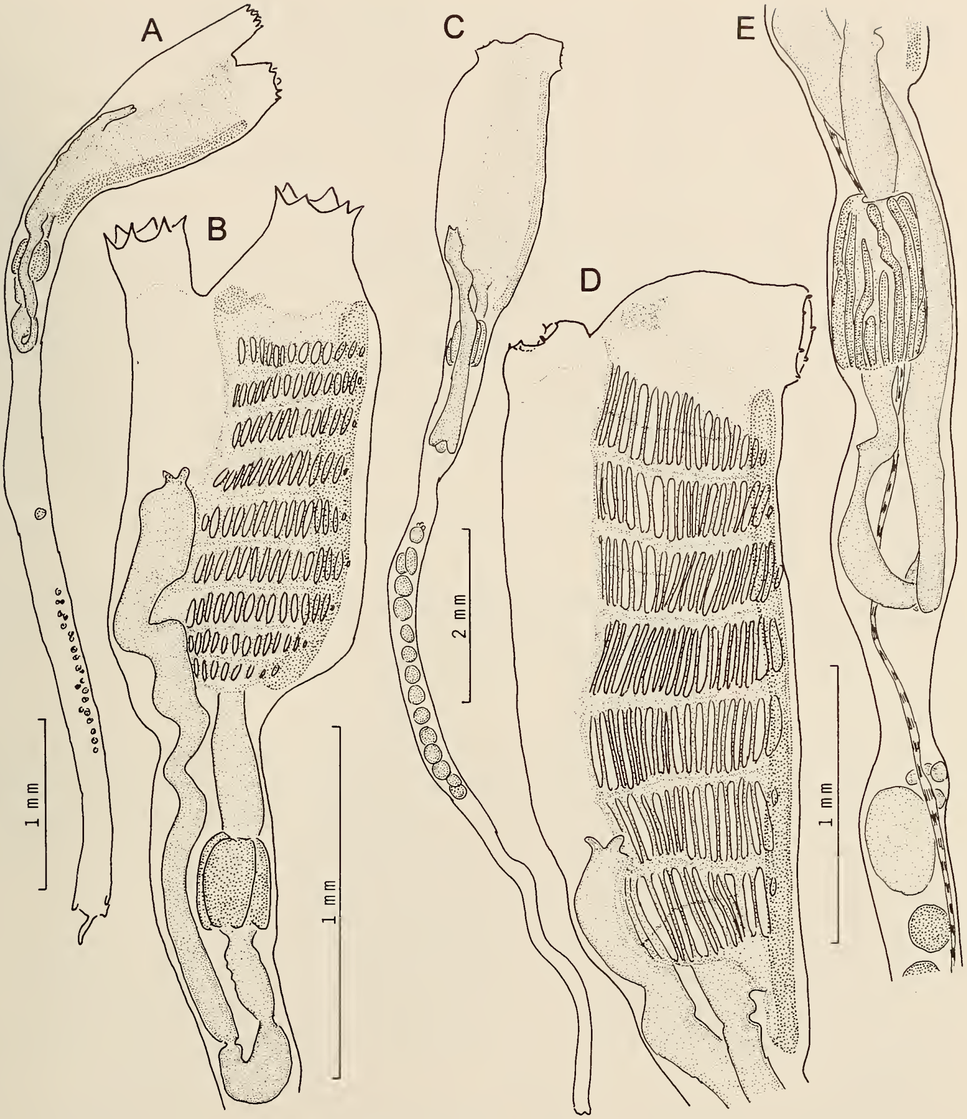

Fig. 13. A–B. *Ritterella solida* sp. nov. A. Zooid. B. Detail of the thorax and abdomen. C–E. *Euherdmania divida* sp. nov. C. Zooid. D. Thorax. E. Abdomen and ovary.

Description

Minute, elongate, stalked zooids, each coated with sand, are joined at their base into the colony. Each zooid is 20 mm long, and 2 mm in diameter at the enlarged distal end. Each cylindrical siphon has six pointed lobes (Fig. 13D). The oral siphon is oriented toward the ventral side. The number of tentacles is variable, most often 16 in three orders of size.

The thoracic musculature is weak in a network of thin transverse and longitudinal fibres, but circular muscles make sphincters around the siphons. The longitudinal thoracic fibres extend over the abdomen and post-abdomen. The branchial sac and endostyle form a posterior horn at the base of the thorax (Fig. 13D).

The branchial sac (Fig. 13D) has 6–7 rows of elongated stigmata, generally with 32 stigmata in the first half row and 20 in the last half row. The first and the last rows have a complete or partial parastigmatic vessel (Fig. 13D). The transverse vessels are low with dorsally 5–6 languets. There are no languets at the level of the parastigmatic vessels. Some stigmata rows occasionally have incomplete parastigmatic vessels. The abdomen is about the same length as the thorax. The oesophagus is short, as long as the stomach. The stomach wall is irregularly folded (Fig. 13E) and 10–12 folds can be counted in transverse sections. The typhlosole is conspicuous. The intestine is thin beyond an annular swelling (Fig. 13E). A constriction before the rectal caeca marks the bottom of the gut loop. The bilobed anus opens at the level of the second to last row of stigmata.

The post-abdomen is very long (Fig. 13C), longer than the thorax plus abdomen.

The ovary, located at some distance from the gut loop, is immediately followed by a line of testicular vesicles that are limited to the anterior half of the post-abdomen (Fig. 13C). No larvae were present in the colonies studied.

Remarks

The genus *Euherdmania* contains few species but is widely distributed in the world. Some of them have massive colonies with zooids grouped in a common tunic. They are *E. gigantea* (Van Name, 1921) in the western Atlantic Ocean, *E. morgani* Millar & Goodbody, 1974, from Jamaica, *E. rodei* Pérès, 1949, from Senegal and *E. solida*, Millar, 1953, from the Gold Coast, in which only the thoraces are isolated. Among the species with separated zooids, many have numerous rows of stigmata, as in *E. areolata* Millar, 1978, from Guyana which has an areolated stomach, *E. claviformis* (Ritter, 1903) from California, *E. digitata* Millar, 1963, from the western Pacific, *E. fasciculata* Monniot, F., 1983, from Guadeloupe, and *E. translucida* Kott, 1992, from southern Australia.

The nearest species to *E. divida* is *E. dumosa* Monniot, F., 1987, from New Caledonia. It has the same colony structure with embedded sand. However, *E. dumosa* has only four rows of stigmata cut by parastigmatic vessels, seven rapheal languets, and a very different stomach in which the wall is slightly spotted. The thoracic muscles and the gonad disposition are similar in both species.

Family **Polycitoridae**

Eudistoma bituminis **F. Monniot sp. nov.**

Fig. 14A–C

Material

Holotype. SAM–A25847, Sodwana Bay, KwaZulu-Natal (27°33'S 32°42'E), intertidal pools, collected by M. Schleyer, Nov. 1994.

Other material. Several colonies, Sodwana Bay, KwaZulu-Natal, intertidal pools (Schleyer coll.); Mayotte, Comoros islands (Gaydou coll.).

Description

The colonies are about 10 mm thick, large, dark pads. They are several centimetres across, tough, encrusted with sand, and resemble bitumen (hence

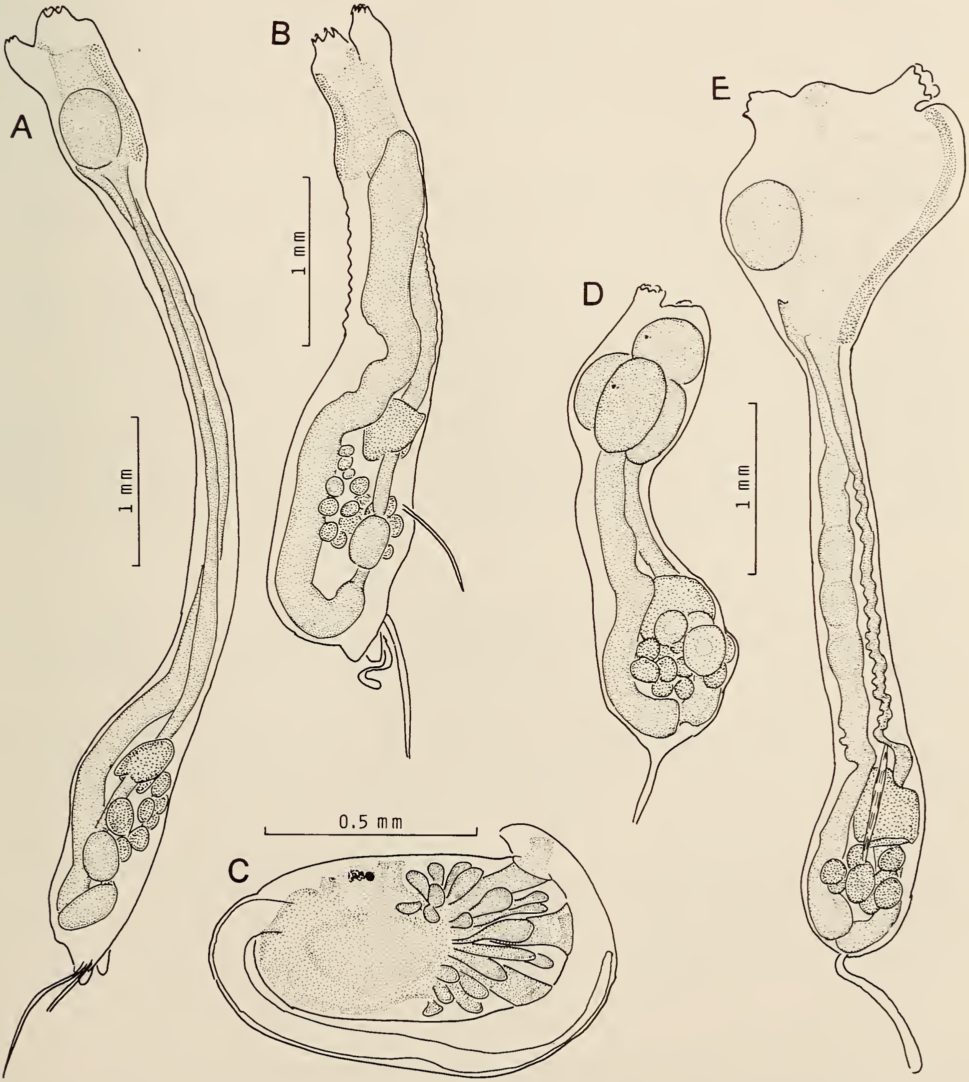

Fig. 14. A–C. *Eudistoma bituminis* sp. nov. A–B. Zooids. C. Larva. D–E. *Eudistoma caeruleum*. D. Zooid from South Africa. E. Zooid from Madagascar.

the species name). The zooid apertures are arranged in circular systems, with the oral and cloacal lobes slightly protruding above the smooth colony surface. The tunic is black in the upper part, slightly more translucent deeper. It contains embedded sand that is more abundant in the interior than at the colony surface. The tunic contains abundant brown pigment cells.

The zooids (Fig. 14A, B) are contracted and light brown in formalin. Both siphons have six sharp lobes. The longitudinal muscles are very strong and extend in two ribbons along the abdomen, making horns at the body extremity. The tentacles are very numerous in a single ring. There is no unperforated space anterior to the branchial sac. The stigmata are very elongated, about 15 per half row. The abdomen is much longer than the thorax. The stomach is as long as it is wide and is followed by a narrow cylindrical section (Fig. 14B). The mid-intestine is wide and short, sometimes as wide as the stomach. The rectum, without caeca, begins after a constriction in the descending limb of the gut loop (Fig. 14B).

The gonads are located within the gut loop, behind the stomach, and consist of a few round testicular vesicles (Fig. 14A, B) and an ovary with several oocytes varying in size. Two or more long vascular processes arise from the centre of the gut loop.

The larvae (Fig. 14C) are incubated in the peribranchial cavity. They have a light brown, elongated trunk 0.8 mm in length and half encircled by the tail. The three adhesive papillae have stout, long, brown stems. They are separated by two double, long, median ampullae. On each side are several long ampullae with shorter ones at their base (Fig. 14C). The number of these lateral ampullae seems a little variable, as well as their shape, but they are always numerous. The ocellus and otolith are present between the embryonic siphons. The branchial sac is not yet differentiated when the adhesive ampullae begin to evert.

Remarks

This *Eudistoma* species is different from other known African species. It differs from *E. atrum* Monniot, F. & Monniot, C., 1997, from Tanzania and Djibouti, which has a black but mucous-covered and naked colony with notably different larvae.

The enlarged mid-intestine and the brown base of the larval adhesive papillae in *E. bituminis* resemble those in the western Pacific species *E. reginum* Kott, 1990, but the latter has different larval anterior ampullae, colonies devoid of sand and an asymmetrical stomach.

Although only collected in Sodwana Bay and Mayotte, Comoros islands, this species probably has a wider distribution in the Indian Ocean.

Eudistoma caeruleum (Sluiter, 1898*a*)

Fig. 14D, E

Distoma caeruleum Sluiter, 1898*a*: 14, pl. 2 (fig. 4), pl. 4 (fig. 11).
Polycitor (Eudistoma) caeruleum: Hartmeyer, 1909: 1431.
Polycitor (Eudistoma) caeruleus: Michaelsen, 1919: 73.

Sigillina (Eudistoma) caerulea: Michaelsen, 1934: 141.
Eudistoma caeruleum: Millar, 1956: 919, fig. 6; 1962: 157, fig. 21; 1964: 163. Plante & Vasseur, 1966: 147, pl. 3 (figs 17–19). Lafargue & Vasseur, 1989: 61.

Material

Several specimens. Sodwana Bay, KwaZulu-Natal, intertidal pools (Schleyer coll.); Thompson's Pool, near Ballito, KwaZulu-Natal (Griffiths coll.); Nosy Bé, Madagascar, 15 m (Laboute coll.).

Description

The colonies are club-shaped and dark blue in colour. Several lobes may arise from a common base. The heads are naked but some epibionts are fixed on the peduncle. The zooids, restricted to the head, do not form systems. They are regularly spaced with the cloacal siphon above the oral siphon. The tunic in the head region is a translucent blue. Dark pigment cells are accumulated around the zooids.

The zooids are a dark or lighter blue, with the siphons darker than the remainder of the body wall. Both siphons are short with six round lobes. The longitudinal and transverse thoracic muscles are regularly spaced in a well-developed network, and longitudinal bundles extend along the abdomen. The oral tentacles are thick in two orders of size, in two circles. The urn-shaped dorsal tubercle protrudes.

The first row of stigmata curves dorsally. In a relaxed zooid, we counted on the right side 35 long stigmata in the first row and 28 stigmata in the two last rows. They are less numerous on the left side. The unperforated areas anterior and posterior to the branchial sac are very narrow (Fig. 14E). The abdomen is a least three times as long as the thorax in relaxed zooids (Fig. 14E). The stomach is asymmetrical at the posterior extremity of the abdomen and the post-stomach and mid-intestine are especially short; the rectum with caeca begins with widening at the bottom of the gut loop. The gonads consist of a cluster of round testis vesicles and a central ovary contained in the gut loop behind the stomach (Fig. 14D, E). The abdomen is prolonged by a thin and very long vascular process, devoid of muscles.

The larvae are brooded in the peribranchial cavity, which contains up to five embryos. The most mature larvae that we found have an ocellus, an otolith, three anterior adhesive papillae but no other differentiation. The tail encircles the trunk, which is 0.5 mm in length.

Remarks and distribution

The colonies and zooids exactly correspond to the type specimen, which has been re-examined. The geographic distribution of this spectacular species extends from KwaZulu-Natal in South Africa to Mozambique, the west coast of Madagascar, and Mayotte (Comoros islands).

Eudistoma hospitale F. Monniot, 1998

Eudistoma hospitale Monniot, F., 1998: 430, figs 1–2. Monniot, F. & Monniot, C., 1999: 19, fig. 13A–C, pl. 2F.

Material

Several colonies. Sodwana Bay, KwaZulu-Natal, 19 m (Schleyer coll.). Gouritz River mouth (Griffiths coll.). Port Elizabeth, intertidal (Monniot coll.).

Description

In South Africa, this ascidian is a fleshy cushion, black at the surface and grey and soft in the interior, with superficial sticky mucus and threads emerging from the siphons. One colony from the southern Cape coast had bright blue specks overlaid on a dark undertone at the colony surface. The colonies are always thick pads with a flat surface or with low swellings. The zooids are arranged in circular systems that are sometimes inconspicuous.

Remarks and distribution

This recently described material has the same structure in all locations and the same filiform symbionts of unknown taxonomic status (Monniot, F. 1998).

This species has a wide geographic distribution, from the south-western Pacific to South Africa and Tanzania, and it also occurs in a wide depth range from low tide down to 30 m.

Eudistoma illotum (Sluiter, 1898)

Fig. 1I, 15A–C

Distoma illotum Sluiter, 1898: 16, pl. 1 (fig. 3), pl. 3 (fig. 7).
Polycitor illotus: Hartmeyer, 1912: 303, pl. 38 (fig. 2), pl. 43 (fig. 5).
Sigillina (Hyperiodistoma) illota: Michaelsen, 1930: 491; 1934: 139.
Eudistoma illotum: Millar, 1955: 181, fig. 12; 1962: 160, fig. 24; 1964: 162, fig. 2.
non *Eudistoma illotum*: Rho, 1971: 110. Rho & Huh, 1984: 106. Rho & Lee, 1989: 65.

Material

Several colonies. Saldanha Bay; Kommetjie; Miller's Point, False Bay; under overhangs intertidally or in pools (Griffiths and Monniot coll.).

Description

The colonies are brown or purple encrusting cushions. The largest specimen in this collection is 90 mm across and 20 mm thick. Paler zooids are visible through a semi-transparent tough tunic. The siphons are not arranged in systems. The tunic contains some faecal pellets and green, spherical inclusions, but no sand.

The zooids are not densely packed. Their siphons are short, equal in size, with six round lobes. The most relaxed zooids reach 10 mm in length but have a thorax only 1 mm long (Fig. 15A). The thoracic musculature consists of a regular network of longitudinal and transverse fibers of equal thickness. The longitudinal muscles extend in bundles along the abdomen. The oral tentacles are numerous, in three orders of size, on three circles. There are unperforated areas anterior and posterior to the branchial sac. In large zooids, the first row of stigmata curves dorsally and contains 20 stigmata on the right side.

The gut forms a long loop and the two limbs are thin and parallel (Fig. 15A). The stomach is laterally flattened with a round outline and the oesophagus enters it dorsally. A longitudinal crest often raises its side near the typhlosole (Fig. 15A) but may have been caused by contraction. The conical post-stomach and ovoid mid-intestine are separated by constrictions. The rectum begins at an expansion of the bottom of the gut loop. The pyloric gland covers a long segment of the rectum with a network of curled tubules.

The heart is not situated inside the gut loop but behind it, in the lower part of the abdomen where the muscles are anchored. Several vascular processes of varied lengths arise on the side of the gut loop.

The gonads, made of a cluster of testis vesicles and a central ovary, lie behind the stomach, inside the gut loop (Fig. 15B). One to five larvae are brooded in the peribranchial cavity. They distend the thoracic body wall and protrude when mature and numerous.

The fully developed larvae (Fig. 15C) have a trunk 1 mm long and three large adhesive papillae on stout stems. Between each of them are two dorso-ventrally flattened vesicles. There are also one dorsal and one ventral vesicle of variable shape. A flat ampulla covers the base of the most dorsal adhesive papilla on each side of the larva.

Remarks and distribution

All the above characteristics correspond well with Hartmeyer's (1912) and Millar's (1962) descriptions of *E. illotum* from the same geographic area. It is not possible to retain as synonyms the Korean specimens identified as *E. illotum*, by Rho (1971) and Rho & Huh (1984) as their descriptions are of a different species.

Eudistoma illotum differs from other species in the Indian Ocean in its larval structure and in the posterior location of its heart behind the gut loop. Its geographic distribution is presently limited to the Western Cape Province, South Africa.

Eudistoma modestum (Sluiter, 1898)

Fig. 15D–H

Distoma modestum Sluiter, 1898*a*: 18.
Eudistoma modestum: Millar, 1962: 158, fig. 22.

Material

Several colonies. Isipingo, KwaZulu-Natal, intertidal (Griffiths coll.); Sodwana Bay, KwaZulu-Natal, intertidal (Schleyer coll.).

Description

The colonies were found on vertical rock faces, which were exposed at low tide. They are pale pink 'buttons', each colony consisting of several erect, club-shaped heads above an encrusting base embedded with sand. The largest lobe is 10 mm in diameter. The zooids can be seen through a glassy tunic, free of foreign matter.

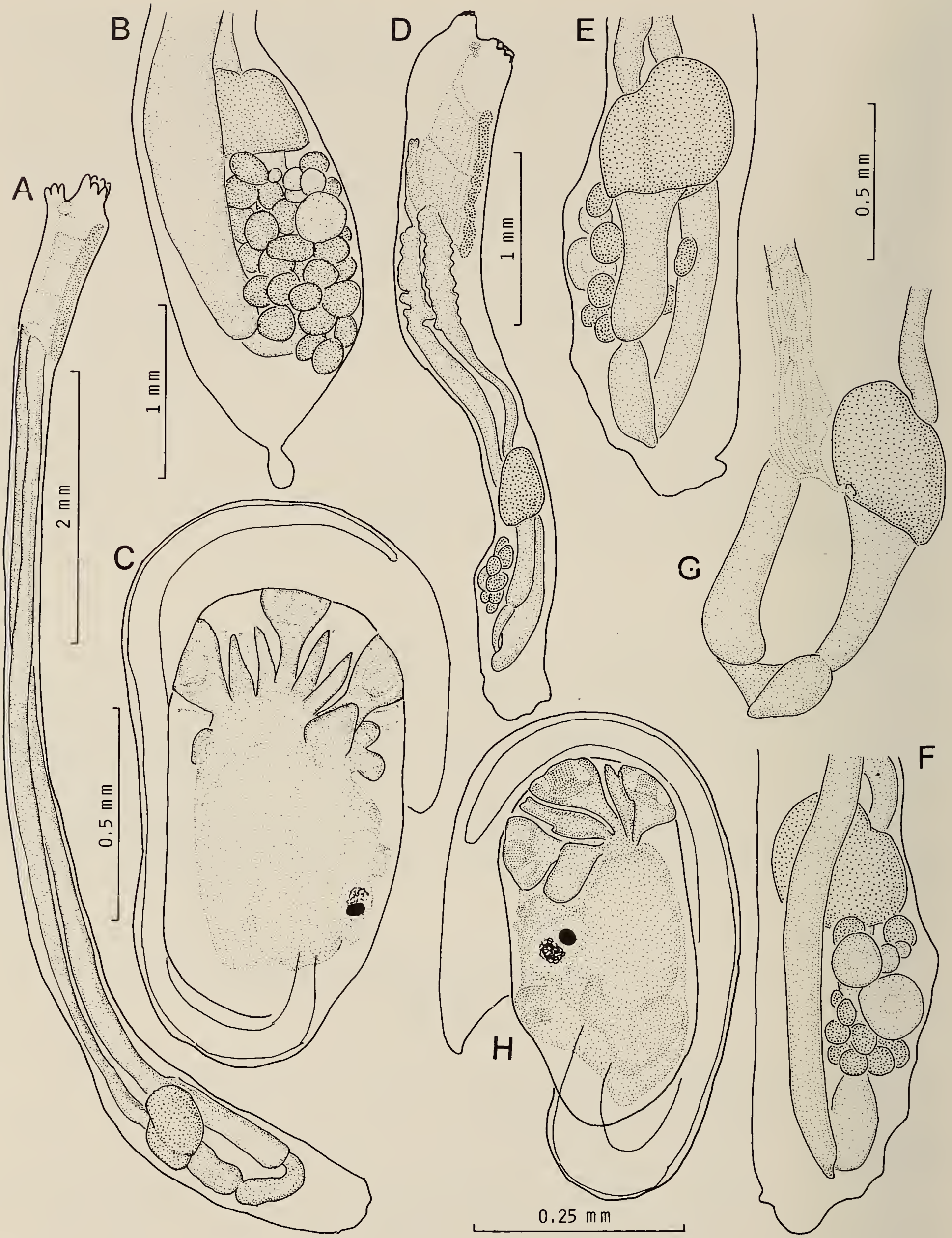

Fig. 15. A–C. *Eudistoma illotum*. A. Zooid. B. Gonads. C. Larva. D–H. *Eudistoma modestum*. D. Zooid. E–F. Both sides of an abdomen. G. Pyloric gland. H. Larva.

The zooids are rather small (Fig. 15D), 5 mm long when relaxed. The thorax represents 25–35 per cent of the total length of the zooid. The siphons are short with six lobes. The thoracic musculature is weak. On the right side there are about 18 stigmata in the first row and 15 stigmata in the second and third rows. The stomach is asymmetrical with a smooth wall (Fig. 15E). It is followed by a long post-stomach and a short mid-intestine. The rectum begins with caeca at the pole of the gut loop (Fig. 15F); it remains straight and parallel with the oesophagus. A pyloric gland of undulating, densely packed parallel tubules (Fig. 15G) covers the rectal wall facing the stomach and more anteriorly. The pyloric duct enters the posterior side of the stomach (Fig. 15G).

The gonads lie in the gut loop. The ovary is central within a group of a few testis vesicles (Fig. 15E, F).

One or two larvae are incubated in the peribranchial cavity. The trunk, three-quarters of which is encircled by the tail, is up to 0.5 mm long. The three adhesive papillae are wide, alternating with three odd ampullae (Fig. 15H). The ocellus and the otolith are present.

Remarks and distribution

At Isipingo, some specimens of *Molgula scutata* had settled between the lobes of *E. modestum.*

This species differs from the smallest colonies of *E. illotum* in its paler colour, the shape of the gut loop and the larvae. It has only been found in South Africa.

***Eudistoma occultum* F. Monniot sp. nov.**

Fig. 16A–D

Material

Holotype. SAM–A25848, Sea Point, Cape Town (33°55'S 18°23'E), intertidal, collected by C. and F. Monniot.

Other material. Several colonies, locality data as for holotype.

Description

Numerous colonies were collected at low tide. They are barely visible in the field (hence the species name), being colourless or pale pink, lobate colonies with a gelatinous surface on a base encrusted with sand and all kinds of foreign matter. The colonies are 20 mm in diameter and consist of several irregular lobes no more than 3 mm thick when fixed. No sand is embedded in their interior.

The zooids (Fig. 16A) are haphazardly intermingled inside the mucous tunic. Most of them are strongly retracted and very short, the most relaxed individuals being 7 mm in length. Both siphons are short with six lobes (Fig. 16A). About 20 longitudinal muscles are regularly spaced on each side of the thorax. There are numerous tentacles in three orders of size. The unperforated areas anterior and posterior to the three rows of stigmata are narrow. Twenty stigmata were counted in the first and third rows but only 15 in the second row.

The abdomen occupies 80 per cent of the body length in relaxed zooids (Fig. 16A). The stomach has a smooth wall, followed by a conical post-stomach

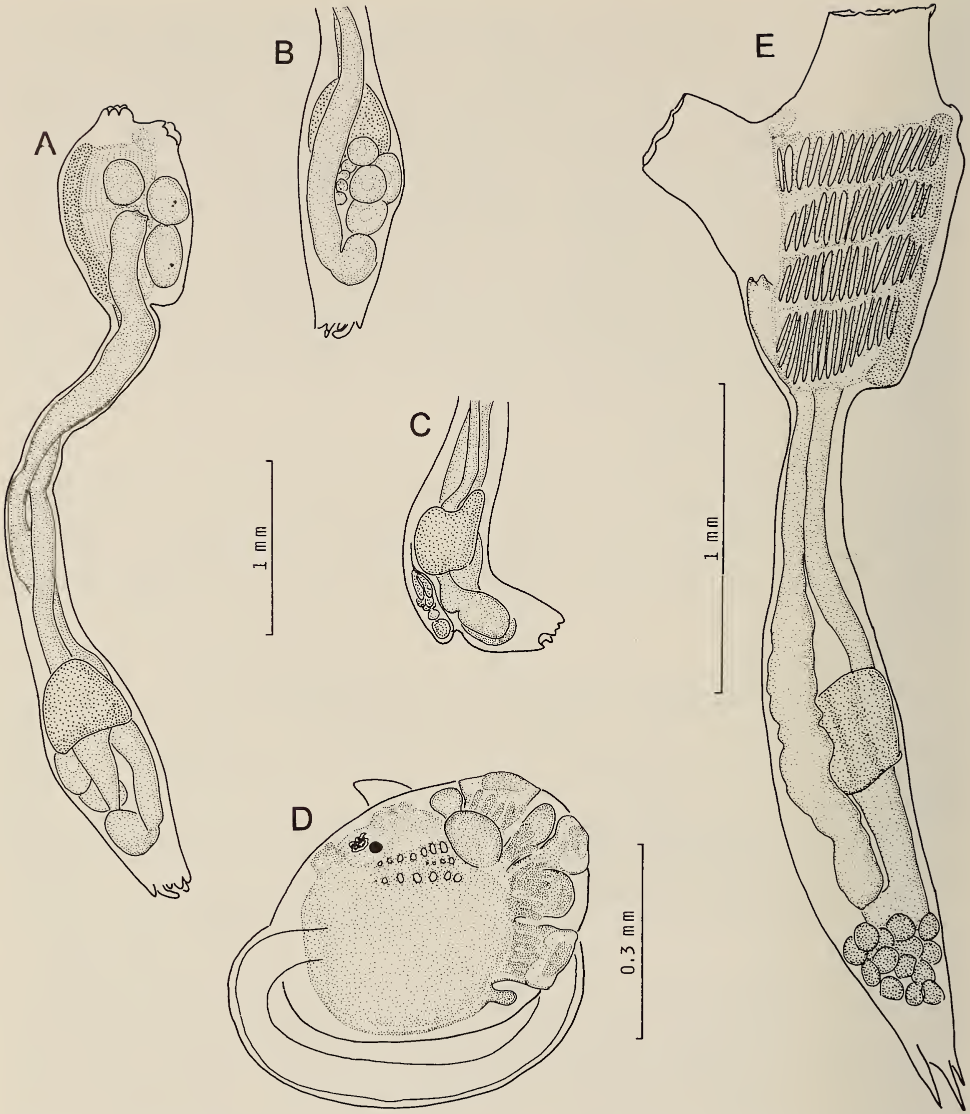

Fig. 16. A–C. *Eudistoma occultum* sp. nov. A. Zooid. B–C. Gut loop of two different zooids. D. Larva. E. *Tetrazona porrecta*. E. Zooid.

and a short mid-intestine well separated by constrictions. The rectum begins at the bottom of the gut loop and parallels the straight oesophagus (Fig. 16A). The gonads (Fig. 16B, C) and the heart are located in the gut loop, behind the stomach. There are one or several short post-abdominal vascular processes (Fig. 16A–C). Five or six embryos are brooded in the distended peribranchial cavity.

Mature larvae (Fig. 16D) are round, the trunk being 0.5 mm long. The three adhesive papillae are short and thick, alternating with four odd ampullae.

There is a flat round vesicle on each side of the dorsal adhesive papilla. A crescent of numerous filiform ampullae lies at the base of the papillae on each anterior side. The larval branchial sac is already pierced with elongated first and third rows of stigmata when the second row remains incomplete (Fig. 16D). The ocellus and otolith are present.

Remarks

This very modest species differs from all other *Eudistoma* species in the Indian Ocean in its small, lobed colonies and the structure of the larva. The second row of stigmata being shorter than the first and third ones is also distinctive.

Polycitor africanus Monniot & Monniot, 1999

Fig. 2A

Polycitor africanus Monniot, F. & Monniot, C., 1999: 22, fig. 13, pl. 3A.

Material

Two colonies, Durban, outer anchorage (Schleyer coll.).

Remarks and distribution

This species is common along the East African coast at shallow depth. It has been collected at Pemba Island (Tanzania), Ibo Island (Mozambique), Nosy Bé (Madagascar) and Durban (KwaZulu-Natal). The present colonies are not sexually mature.

Tetrazona porrecta Millar, 1962

Fig. 16E

Tetrazona porrecta Millar, 1962: 146, fig. 15.

Material

Two colonies, Oudekraal, Cape Peninsula, 8 m and 9 m (Griffiths coll.).

Description

The colonies are encrusted with sand and form white small pads or crusts, irregular in outline and 10–20 mm in diameter. The tunic is tough. Both siphons of the zooids open at the colony surface with no arrangement into systems. The cylindrical siphons are spaced well-apart at the same level and have six short lobes (Fig. 16E). The oral tentacles are distributed in three circles. The branchial sac has 16–18 stigmata on each side in the first of the four rows.

The abdomen is narrower than the thorax and most often folded under it. The stomach is located midway down the gut loop and its wall has six longitudinal folds. In these specimens only male gonads are present at the bottom of the gut loop, with the testis vesicles compacted together in a tight mass. The heart lies behind the gut loop. Some vascular processes prolong the abdomen.

Remarks and distribution

The newly collected specimens correspond well to Millar's (1962) description. The species is common on the fronds of the red alga, *Epymenia*; it has only been recorded from South Africa.

The only other species of *Tetrazona* is the Antarctic *T. glareosa* (Sluiter, 1906), which is very different, being closer to the Holozoinae, and containing spicules (Monniot, C. & Monniot, F. 1983: 37, fig. 6E–G).

Cystodytes dellechiajei (Della Valle, 1877)

Figs 2B, 17

Distoma dellechiajei Della Valle, 1877: 40.

Material

Several colonies. Woolley's Pool, False Bay, intertidal; Isipingo and Sodwana Bay, KwaZulu-Natal, 15–20 m (Griffiths, Schleyer and Monniot coll.).

Description

The colonies look remarkably different depending on their size, stage of zooid development and the abundance of spicules. Some of the pink colonies from False Bay, which are at least 100 mm across and 10 mm thick, have densely distributed disc-shaped spicules around the zooids and elsewhere throughout the tunic mass. Others lack any well-formed spicules, having only irregular crystals in some places. When abundant, the disc-shaped spicules, which have a smooth thin edge and a maximum diameter of 250 μm, encapsulate the zooids. Smaller discs are crowded throughout the semi-opaque or transparent tunic. The spicule density varies from place to place within the same colony.

All of the colonies have zooids grouped into systems with 4–10 oral apertures in a ring and the cloacal apertures juxtaposed in the centre of each system. The colony surface is flat. Pigment cells are sometimes numerous throughout the tunic thickness, and sometimes restricted to a thin layer around the calcareous capsules. The zooids are not pigmented.

The less contracted zooids (Fig. 17A) are 5 mm long and perpendicular to the colony surface. They are generally partially or fully retracted into the spicule capsules if these are present. Both siphons have six round lobes. The oral tentacles in 3–4 orders of size regularly alternate along a single ring.

The thin thoracic muscles are mostly longitudinal and regularly spaced, they converge in two ribbons along the abdomen. Unperforated areas extend in front of and beneath the branchial sac (Fig. 17A). The four rows of stigmata are separated by high transverse membranes. The first stigmata row, with about 20 perforations on each side, is curved dorsally. In the most relaxed zooids the waist is long and the body wall forms an asymmetrical fold on its side (Fig. 17A), which is sometimes large but in others hardly visible.

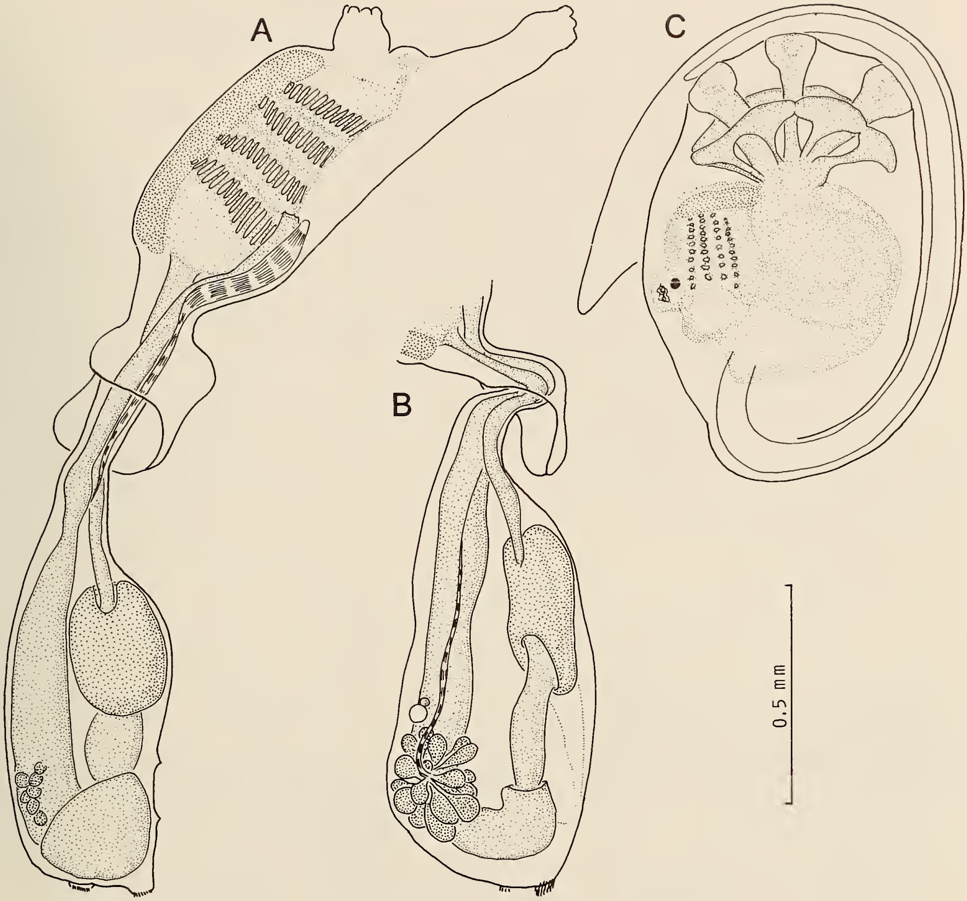

Fig. 17. *Cystodytes dellechiajei*. A. Zooid. B. Gonads. C. Larva.

The gut loop is not twisted. It is divided into a narrow oesophagus, a wide smooth-walled stomach, a narrow post-stomach and a wide rectum beginning in the descending limb of the gut loop (Fig. 17B). When mature, the testis has many lobes in a cluster (Fig. 17B). The ovary begins to develop against the testis lobes, which disappear as the oocytes reach a large size and protrude outside the abdomen. The eggs remain in the oviduct in a pouch of the body wall hanging from the waist.

The larvae (Fig. 17C) have a trunk 1 mm long, the tail being coiled in about half a turn around it. The ocellus and the otolith are present and four rows of stigmata are already differentiated. The three adhesive papillae are linearly arranged in the centre of terminally fused ampullae supported by their bases as four pillars on each side.

Two or three vascular processes of variable length are sometimes present on the side of the abdomen.

Remarks and distribution

Except for European collections, we do not accept previous identifications from distant geographic areas without seeing well-preserved and mature colonies. Thus, no further synonymy is given here.

Variability in *C. dellechiajei* at the same station and even within a same large colony is surprising. We have tentatively, but unsuccessfully, tried to find significant differences allowing us to describe geographically separate species. The tunic is transparent or opaque and the colour in life varies from white to pink and purple. The spicules may be abundant, well-formed or absent, with all possible intermediates. The anatomy of the zooids is very difficult to compare as they are never totally relaxed. The number of testis lobes increases during growth; these are radially arranged at the beginning and later compressed in a cluster. The larval size is also variable.

The colours and spicule density seem less variable in material from the eastern Atlantic Ocean and the western Mediterranean Sea than from the eastern Mediterranean Sea. The variability of South African material identified as *C. dellechiajei* thus precludes establishing a new species, a conclusion also drawn by Millar (1962).

Distaplia skoogi Michaelsen, 1934

Figs 2C, 18A–C

non *Holozoa domuncula* Hartmeyer, 1913.
Distaplia domuncula: Millar, 1955: 187, fig. 15.
Distaplia skoogi: Michaelsen, 1924: 331, nov. nom. for *Distaplia domuncula* Michaelsen, 1923*a*: 15, fig. 3.

Material

Several colonies. Miller's Point, False Bay, 4–15 m (Griffiths coll.).

Description

The colonies are large pads or balls, white, cream, mauve or light brown. The common cloacal apertures open in simple holes with an unpigmented rim. The zooids form conspicuous round systems as the oral siphons are circled with white. The zooids are limited to the superficial layer of the colony. The oral siphon has six low lobes. The cloacal siphon is either elongated in a tube with no languet (Fig. 18B), or widely opened between a wide anterior lobe and a posterior body wall extension (Fig. 18A). The thoracic musculature is thin with regularly spaced oblique fibres. The four rows of stigmata are crossed by parastigmatic vessels (Fig. 18A). There are 20–22 stigmata per side in the first rows. The zooids are colourless except for the stomach, which is brown. The stomach wall has internal thin ridges or areoles (Fig. 18A). The gut loop is wide with a central pyloric ampulla (Fig. 18A). The gonads hang in a pedunculate pouch behind the abdomen, with the testis vesicles clustered around a central ovary (Fig. 18C).

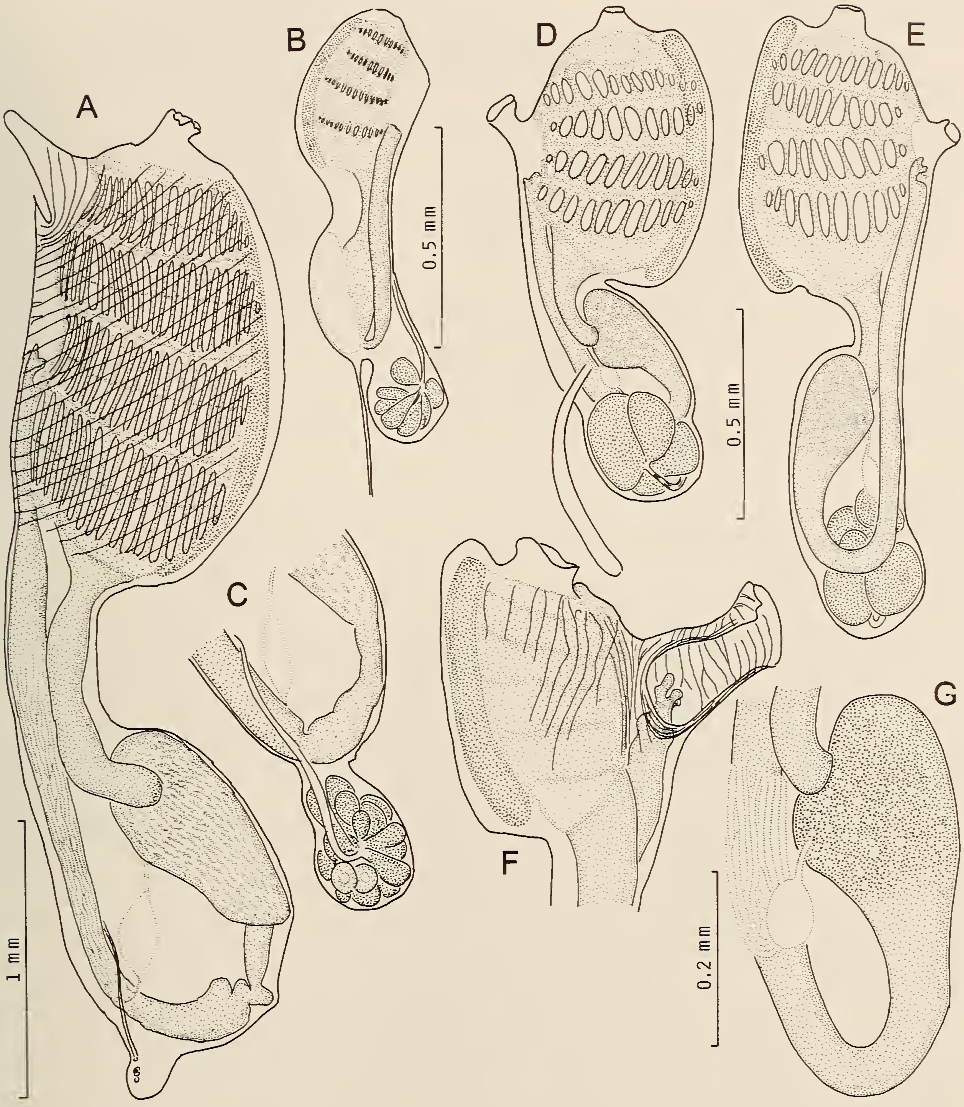

Fig. 18. A–C. *Distaplia skoogi*. A. Fully developed zooid. B. Zooid bud with gonads. C. Gonads. D–G. *Sycozoa arborescens*. D–E. Zooids. F. Thoracic musculature. G. Digestive tract.

The zooids were very young in the colonies examined and no trace of an incubatory pouch or larvae was found, but gonads already appear in young buds.

This species corresponds well with Millar's (1955, 1962) descriptions for *D. domuncula*. Our colonies were not attached to crabs but occur on hydroids or soft corals.

Remarks and distribution

Among the species that also have a smooth stomach wall and gonads in a pouch below the abdomen, *D. prolifera* Kott, 1990, from western Australia, differs by its encrusting colonies. *Distaplia domuncula* (Hartmeyer, 1913), from False Bay, also has thick colonies with zooids in circular systems, but the gonads were not developed.

Distaplia skoogi has been recorded from the Cape area, but has also been collected by Monniot in 1995 at Ibo Island in Mozambique.

Sycozoa arborescens Hartmeyer, 1912

Figs 2D, 18D–G

Sycozoa arborescens Hartmeyer, 1912: 316, pl. 38 (fig. 6), pl. 43 (fig. 6). Millar, 1962: 147, fig. 16; 1964: 166, fig. 5.

Material

One colony, intertidal cave in Old Harbour, Hermanus (Griffiths coll.).

Description

Several lobes arise from a common base, with round or laterally flattened heads held on narrower peduncles. The zooids are arranged in vertical double rows in the head, along cloacal channels. The common cloacal apertures form an oval line internal to the edge of the flat upper surface of each lobe. The colour in life is red and the tunic is translucent. No foreign matter adheres to the tunic.

The zooids measure 1–1.5 mm in length. The oral siphon is cylindrical without lobes (Fig. 18D, E). The cloacal siphon is either in a tube or gapes more with a wide upper languet (Fig. 18F). The four rows of 12–14 stigmata are grouped in pairs in the younger zooids (Fig. 18D, E). The abdomen is the same length as the thorax. The stomach tapers posteriorly with no differentiation into the intestine (Fig. 18G). Its wall is smooth, but it is slightly spotted when stained. A large pyloric ampulla (Fig. 18G) is located inside the gut loop, and joins longitudinal parallel tubules which surround the intestine to the anterior part of the stomach. The colonies in this species are dioecious The colonies examined were only male. Four to six testis vesicles at the bottom of the gut loop protrude posteriorly (Fig. 18E). The sperm duct emerges posteriorly from the centre of the barrel-shaped group of testis vesicles and curves anteriorly to follow the rectum. No ovary or brood pouch were present.

Remarks and distribution

The present colonies correspond well with Hartmeyer's (1912) and Millar's (1962, 1964) descriptions of *S. arborescens*, except for the common cloacal apertures. Hartmeyer (1912) mentioned a single cloacal aperture on the top of each lobe, but his plate 38 (fig. 6) suggests several apertures at the top of each cloacal channel. Millar did not describe the common cloacal apertures and his figures are not clear. Hartmeyer's type (ZMB 2778) was examined and clearly shows one common cloacal aperture at the top of each cloacal channel, and all apertures placed around a dense core of tunic.

Sycozoa arborecens is only known from South Africa.

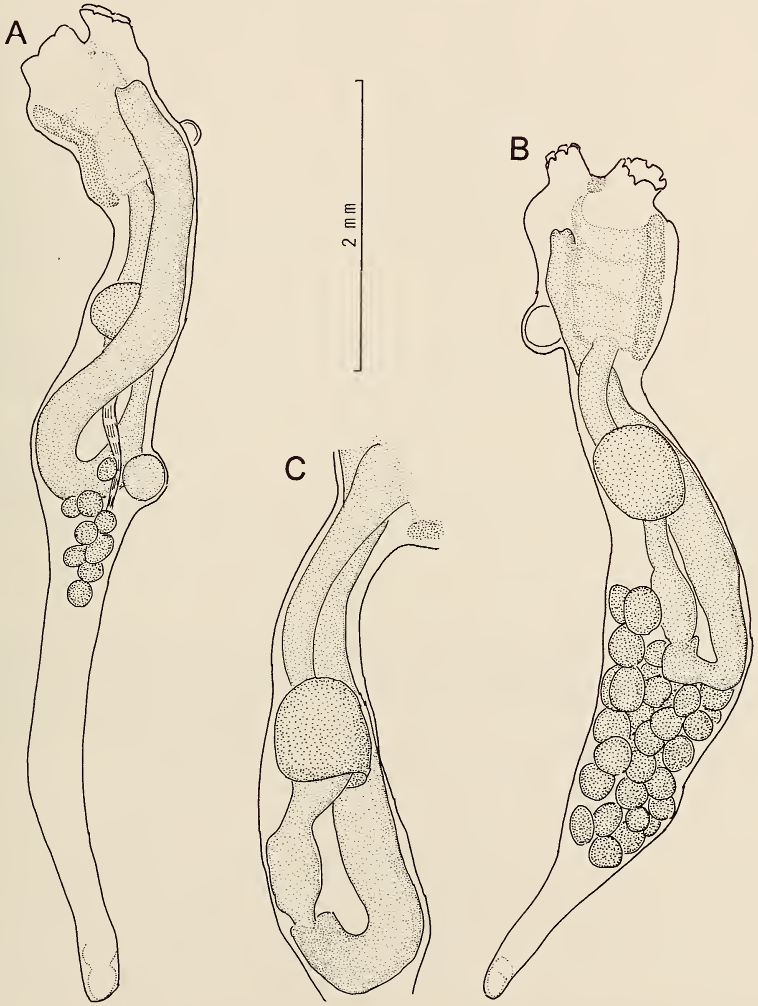

Fig. 19. *Sigillina digitata*. A–B. Zooids. C. Details of the gut.

Sigillina digitata (Millar, 1962)

Figs 2E, 19

Eudistoma digitata Millar, 1962: 155, fig. 20; 1964: 163.

Material

Several colonies, False Bay, in pools; Oudekraal, Cape Peninsula, 2–15 m (Griffiths coll.).

Description

Numerous colonies were collected in pools at low tide and deeper down to 15 m depth in the Western Cape area. They are large, very soft masses of irregular lobes, some of them 150 mm across, either white, pink, or pale brown. They are very often inhabited by numerous amphipods.The zooids open both their siphons independently at the colony surface without any arrangement into systems. The tunic is transparent and has a thin surface layer more resistant than the gelatinous internal matrix.

The zooids are perpendicular to the colony surface with six lobed siphons opening at the same level (Fig. 19A, B). The 24 tentacles alternate regularly in three orders of size. The branchial sac has about 25 stigmata in a half-row. About 20 thoracic longitudinal muscles extend through the abdomen and farther to the long post-abdominal process. The stomach has a smooth wall. It is followed by a wide mid-intestine that is clearly separated from the rectum by a constriction in the descending limb of the gut (Fig. 19C).

The gonads consist of a long cluster of testis vesicles lying partially on the gut loop and extending beyond it (Fig. 19B), and an ovary in the centre of the testis (Fig. 19A). A long post-abdominal process contains longitudinal muscle fibres and reserve cells. The heart is located inside the gut loop.

No larvae were found in the colonies examined, but a dilation of the posterior part of the cloacal cavity containing an egg (Fig. 19B) was observed in zooids having gonads.

Remarks and distribution

The present specimens collected in the Western Cape Province correspond well with Millar's descriptions of samples collected in the same area. The gonadal extension under the gut loop is a characteristic of the species, even when no larvae are present.

The distribution of *S. digitata* is restricted to South Africa.

Family **Clavelinidae**

Clavelina lepadiformis (Müller, 1776)

Fig. 2F

Ascidia lepadiformis Müller, 1776: 226.
Clavelina lepadiformis: see Berrill, 1950: 70, figs 14–15. Brunetti, 1987: 102.

Material

Several colonies. Knysna Estuary and Port Elizabeth Harbour (Griffiths and Monniot coll.).

Distribution

This European species, well defined by its morphology and square stomach, has recently been introduced to South Africa, probably on ship hulls. *Clavelina lepadiformis* was previously recorded only along the European coast from the latitude of Trondheim (Norway) down to the Mediterranean Sea, but has not been found on the African Mediterranean coast. Isolated or introduced populations have also been found in Morocco, Madeira and Azores Islands.

Family **Didemnidae**

Trididemnum cerebriforme Hartmeyer, 1913

Figs 2G, 20, 24A

Trididemnum cerebriforme Hartmeyer, 1913: 139, pl. 7 (fig. 1), pl. 8 (figs 4–5); Millar, 1982: 55, synonymy. Monniot, C. & Monniot, F., 1976*a*: 363. Monniot, F., 1990: 518, fig. 1. Nishikawa, 1990: 75.

Material

Several colonies. Saldanha Bay to Port Elizabeth (Griffiths and Monniot coll.). Sodwana Bay, KwaZulu-Natal (Schleyer coll.). Mozambique (Monniot coll.).

Description

Colonies of *T. cerebriforme* are very common along the South African coast but vary remarkably in appearance. These range from thin encrustations to thick colonies with a convoluted surface, but the consistency is always firm. Their colour varies from light grey to pink-grey or dark grey. The colour and thickness may vary in the same colony. In life the surface of the colonies is smooth; when fixed the oral siphons protrude slightly, the spicules preventing retraction. The basal layer of the colonies, in which the spicules are less dense, often includes foreign matter.

The size of the zooids is also variable, being much larger in the thicker areas than in thinner parts of the same colony. The oral siphon is either short and lobeless or cylindrical with six lobes (Fig. 20A). It may be colourless or contain black pigment. A black spot is located at the anterior extremity of the endostyle. The cloacal siphon is tubular and differently oriented according to the position of the zooid in the colony. The cup-like lateral thoracic organs, at the level of the third stigmata row, may attain a very large size (Fig. 20A) or remain small. There are 8–10 stigmata in the first row. The retractor muscle emerges from the oesophageal peduncle (Fig. 20A) and can be longer than the thorax.

The abdomen has no special characteristics. The gut loop is straight or more or less twisted. The testis vesicle is conical (Fig. 20B) and covered with seven or, rarely, nine sperm duct coils. The ovary develops after the testis.

The larvae are colourless and variable in size and structure in the same colony (Fig. 20C, D). They possess an ocellus and otolith, three adhesive papillae and on each side a variable number of lateral ampullae. At the beginning of their development, these ampullae are well separated with four on each side (Fig. 20C). During growth they increase in length and either remain undivided or divide partially or fully, becoming bifid or doubled (Fig. 20D). As a result there may be four, six, seven or eight ampullae on each side.

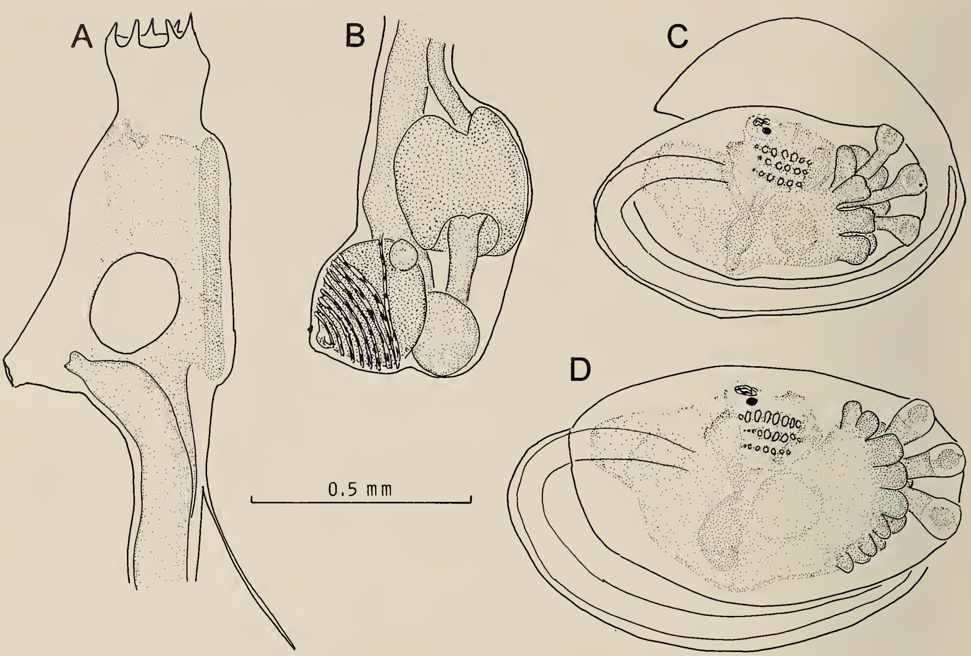

Fig. 20. *Trididemnum cerebriforme*. A. Thorax. B. Abdomen. C–D. Larvae.

The spicules always have the same stellate shape with sharp rays (Fig. 24A). Their abundance is variable from one colony to another. They are always dense in the upper layer, especially around the oral apertures, but often less numerous in the basal tunic. The spicule size and the number of rays are variable, independent of the size of the colony.

Remarks and distribution

This species has always raised difficulties in its identification in different parts of the world, and doubts remain about its being a single species. The variability is universal, and nobody has been able to find distinctive characteristics allowing the separation of species. It was first described in South Africa but has since been found throughout the Western Indian Ocean, around Australia, in the western tropical Pacific Ocean, and off Japan.

***Didemnum aures* F. Monniot sp. nov.**

Figs 21, 24B

Material

Holotype. SAM–A25849, Port Elizabeth (33°59'S 25°39'E), intertidal, collected by C. and F. Monniot, 14 Feb. 1996.

Other material. Several colonies, Gerickespunt (Sedgefield), intertidal (Monniot coll.).

Description

This spectacular species forms large, bright red crusts 2–3 mm thick and commonly 100 mm across. The colonies are smooth but appear convoluted growing on uneven substrata such as algae, sand, shells, polychaete tubes and many hard surfaces. The margin of the colonies is thick. The cloacal channels are wide at the thoracic level, but narrower channels cross the deeper part of the tunic. The stellate spicules are crowded throughout the full thickness of the colonies.

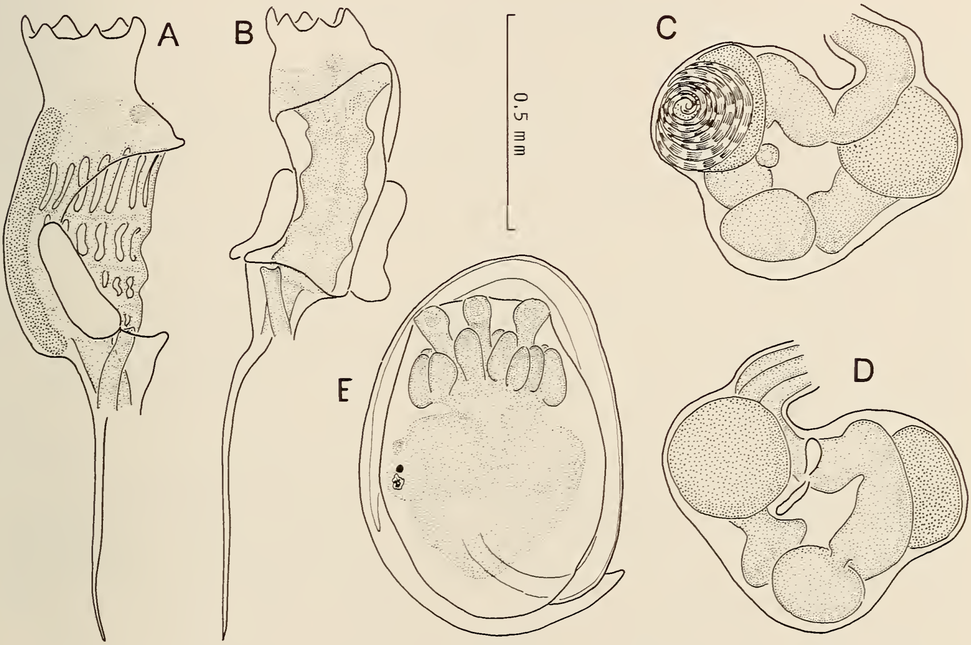

Fig. 21. *Didemnum aures* sp. nov. A–B. Thorax. C–D. Both sides of the abdomen. E. Larva.

The oral siphon is cylindrical, only slightly narrower than the long thorax (Fig. 21A). The cloacal aperture is wide, extending along the four rows of stigmata (Fig. 21A, B). There is no languet. On each side of the body wall, on the margin of the cloacal aperture, a very large leaf-shaped lateral thoracic organ protrudes like ears (giving the species its name) (Fig. 21A, B). We counted 6–7 stigmata in the first half row (Fig. 21A). The retractor muscle is at least as long as the thorax (Fig. 21B). The abdomen is folded under the thorax. The gut loop has the usual shape with well-separated components (Fig. 21C, D); it is folded on itself. The single testis vesicle (Fig. 21C) protrudes and is covered by 7–9 coils of the sperm duct; it is pushed aside over the rectum when a large oocyte develops.

Larvae were found in samples from Port Elizabeth (Fig. 21E). The trunk is 0.75 mm long and encircled by the tail. The visceral mass is separated from the anterior ampullae and papillae by a constriction. The three parallel adhesive papillae are encircled by 12–16 ampullae, which are not regularly spaced or necessarily of equal size. The larvae have no buds.

The spicules (Fig. 24B) are small, the largest 33 μm in diameter, and are stellate with few conical rays.

The main distinctive characteristics of this species are the size and shape of the lateral thoracic organs, and the structure of the anterior ampullae of the larva.

Didemnum epikelp F. Monniot sp. nov.

Figs 22, 24C

Material

Holotype. SAM–A25850, Gerickespunt (Sedgefield) (34°02'S 22°45'E), intertidal, collected by C. and F. Monniot, 14 Feb. 1996.

Other material. Several colonies, locality as above, intertidal (Monniot coll.).

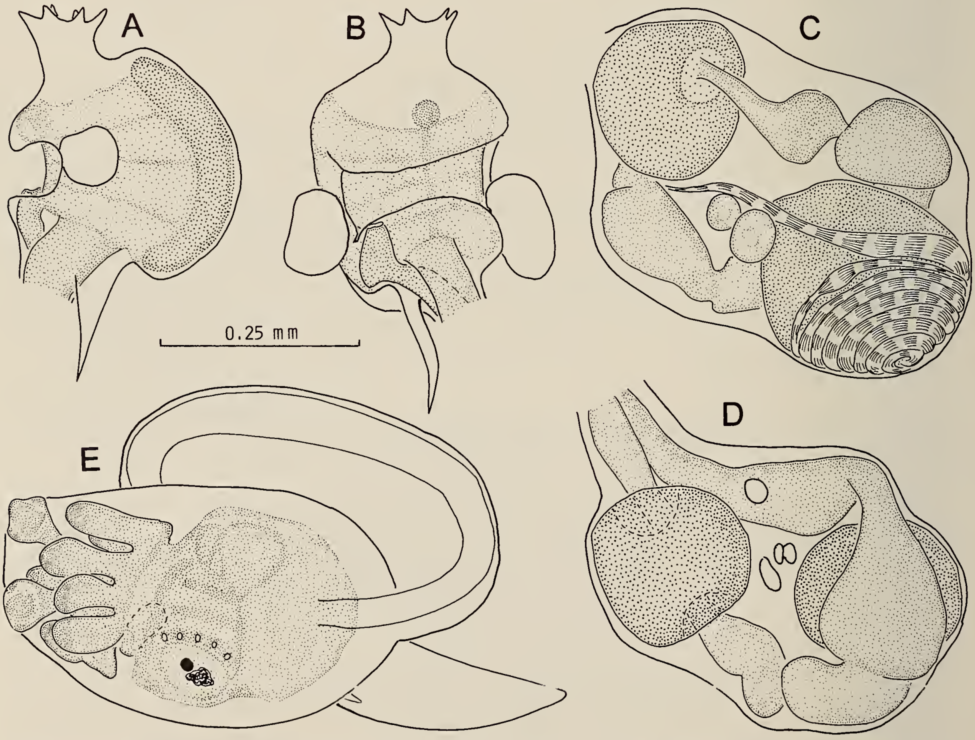

Fig. 22. *Didemnum epikelp* sp. nov. A–B. Thorax. C–D. Both sides of the abdomen. E. Larva.

Description

This white species encrusts kelp roots (hence the species name) in 1-mm thick sheets of irregular outline. The colony surface is smooth. The tunic is filled with spicules and is hard but not brittle. The zooids are small, 0.8 mm in length when extended; the abdomen is normally folded under the thorax.

The oral siphon has six sharp lobes (Fig. 22A). The thorax is generally contracted and the cloacal opening forms a simple hole or a transverse slit (Fig. 22B) without a languet. The lateral thoracic organs are round leaves (Fig. 22A, B) that protrude from the body wall mid-way down the thorax but at some distance from the rim of the cloacal aperture. The waist is short. A short retractor muscle arises from the base of the thorax (Fig. 22A, B).

The abdomen is larger than the thorax (Fig. 22C, D). The gut loop is twisted. The stomach is spherical, large, followed by a post-stomach with an annular swelling, a short mid-intestine, and a rectum of variable diameter but always enlarged at its beginning. A large testis vesicle covers part of the abdomen. Nine coils of the sperm duct are tightly pressed against the external side of the spherical vesicle (Fig. 22C). The ovary develops in the middle of the gut loop.

The larvae (Fig. 22E) have an elongated trunk 0.45 mm long. An ocellus, otolith and some branchial perforations are present, but no bud. There are only two adhesive papillae, with four pairs of digitate ampullae on each side (Fig. 22E). In less advanced stages of development, the young tadpoles have only three pairs of digitate anterior ampullae.

The spicules (Fig. 24C) are stellate, with short rays that are frequently cut at their extremity. Their average diameter is 30 μm.

Remarks

This species has no special characteristics except the elongated larval trunk with only two adhesive papillae. The thin crusts of this white didemnid with tiny zooids do not correspond to the description of any other species of *Didemnum* in the South African area. It may have been previously collected but wrongly identified as *Didemnum candidum* (Savigny, 1816), as has occurred with many other white *Didemnum* species worldwide. Lafargue (1974) established a neotype of *Didemnum candidum* after she studied numerous colonies from the Red Sea. Her description mentions larvae with three adhesive papillae.

Didemnum globiferum **F. Monniot sp. nov.**

Figs 2H, 23, 24D

Material

Holotype. SAM–A25851, Kommetjie, Cape Peninsula (34°08'S 18°19'E), intertidal, collected by C. and F. Monniot, 5 Feb. 1996.

Other material. Several colonies, locality and collection details as above.

Description

The colonies encrust hard substrata in thin sheets about 1 mm thick and commonly more than 100 mm across. Live specimens are pure white. The common cloacal apertures are inconspicuous. The oral siphons are evenly distributed, and form small holes on the very flat and smooth colony surface, giving it a spotted pattern. The spicules are densely packed throughout the tunic, and the colonies would be brittle but for their thinness. The cloacal channels are limited to the thoracic level. The abdomens of the zooids are folded under the thoraces.

The oral siphon has six pointed lobes (Fig. 23A). The cloacal aperture is large in relaxed zooids (Fig. 23A) but narrow in other parts of a same colony. There is no languet. The lateral thoracic organs protrude above the two last stigmata rows (Fig. 23A, B). There are 6–7 stigmata per side in the first branchial row. The retractor muscle originates from the oesophageal peduncle, and it is shorter than the thorax (Fig. 23A, B).

The gut loop has the usual shape found in the genus, the intestinal segments being without apparent separations. A single large, conical testis lobe protrudes from the middle of the gut loop and is covered by 7–9 coils of the sperm duct (Fig. 23C). The ovary lies at the side of the testis (Fig. 23C).

The larvae (Fig. 23D) have an oval trunk 0.5 mm long with the tail encircling three-quarters of the perimeter. An ocellus and otolith are present. The three narrow adhesive papillae have four round ampullae on each side. The larva is not gemmiparous.

The spicules are spheres, providing the species name, and the largest are 40 μm in diameter. They consist of numerous rays, formed from parallel fibres of similar length (Fig. 24D).

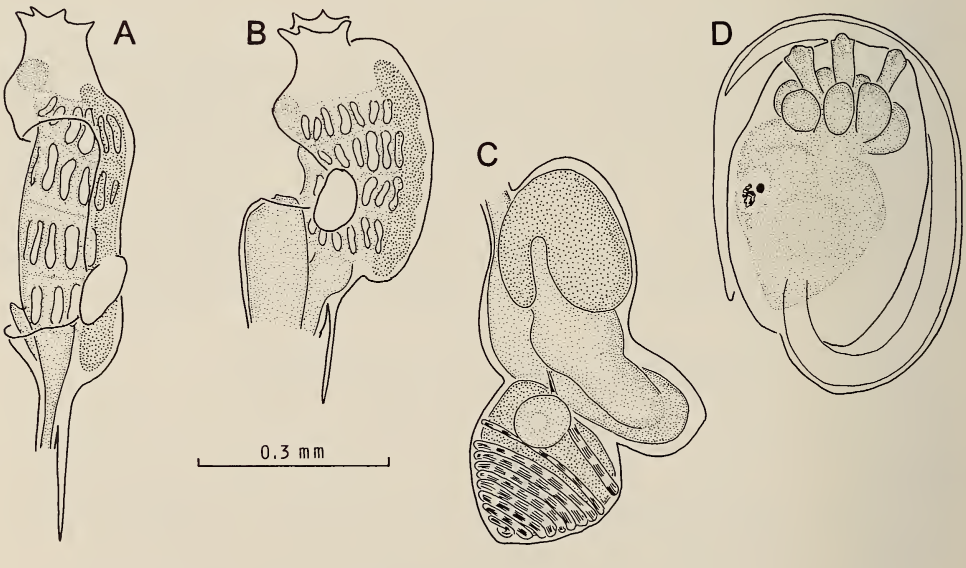

Fig. 23. *Didemnum globiferum* sp. nov. A–B. Thoraces. C. Abdomen. D. Larva.

Remarks

This species looks like *D. epikelp*, but the colonies are larger and the zooids are slightly different, and the larvae have three adhesive papillae instead of two. The spicules are quite different, being spherical but not stellate.

Didemnum globiferum sp. nov. has spicules quite different from *Didemnum candidum* Savigny, 1816, as redescribed by Lafargue (1974) or *Didemnum stilense* Michaelsen, 1934.

Didemnum granulatum Tokioka, 1954

Didemnum moseleyi f. *granulatum* Tokioka, 1954: 244.
For a detailed synonymy see Monniot, F., 1994: 311.

Material

Several colonies. Port Elizabeth (Monniot coll.); Isipingo and Thompson's Pool, near Ballito, KwaZulu-Natal, intertidal (Griffiths coll.).

Description

The thin colonies are white or yellow with a rugose surface. The common cloacal openings have a radially striated rim due to the arrangement of the spicules in converging lines, a strong characteristic of this species. The cloacal channels are wide as the very wide cloacal siphons of the zooids uncover most of the branchial sac.

Remarks and distribution

All characteristics of the zooids and larvae correspond well to the description of specimens collected in many other areas.

This species is widely distributed. It has been recorded in the western Pacific off Japan, Fiji, New Caledonia, Australia, Polynesia, Hong Kong; and in the Indian Ocean off South Africa, Mozambique, Tanzania and in the Red Sea. It has also been found in the Atlantic Ocean off Brazil.

***Didemnum leopardi* F. Monniot sp. nov.**

Figs 3A, 25, 29A

Material

Holotype. SAM–A25852, Sodwana Bay, KwaZulu-Natal (27°33'S 32°42'E), 14–15 m. Collected by M. Schleyer, Dec. 1992.

Other material. Two colonies, locality details as above (Schleyer coll.).

Description

The three colonies are the same in appearance. They form thin and hard crusts, about 1 mm thick, with the surface slightly but regularly raised in small white spots caused by accumulations of spicules. A pinkish brown network is evident between these spots. The dark holes of the regularly spaced common cloacal apertures give the surface a leopard-skin aspect (hence the species name). The spicules are densely packed throughout the tunic. Large, brown, spherical cells are numerous, especially in the superficial layer of the colony, and probably represent symbiotic unicellular organisms. Brown pigment cells

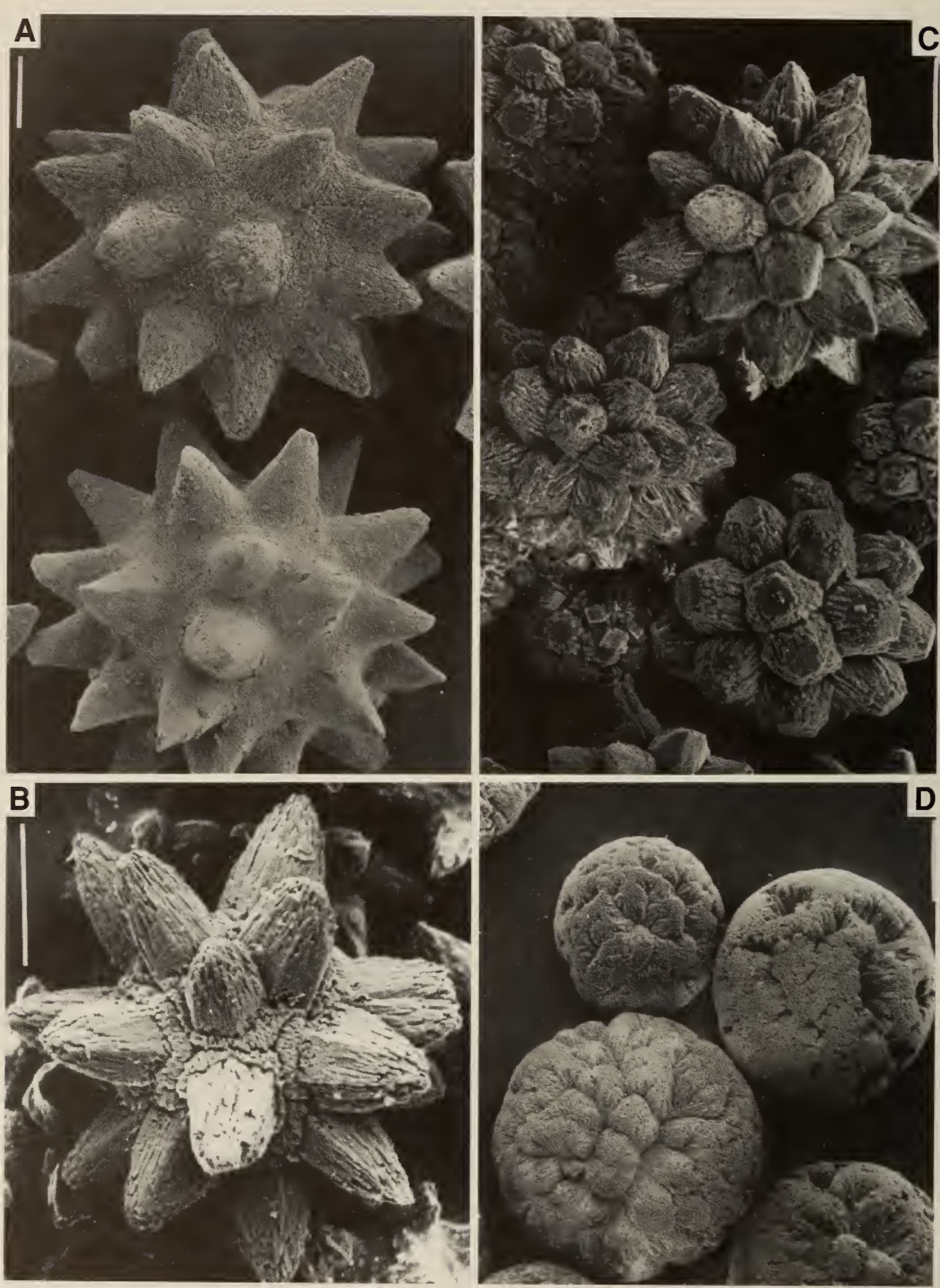

Fig. 24. Spicules. A. *Trididemnum cerebriforme*. B. *Didemnum aures* sp. nov. C. *Didemnum epikelp* sp. nov. D. *Didemnum globiferum* sp. nov. Scale bars = 10 μm.

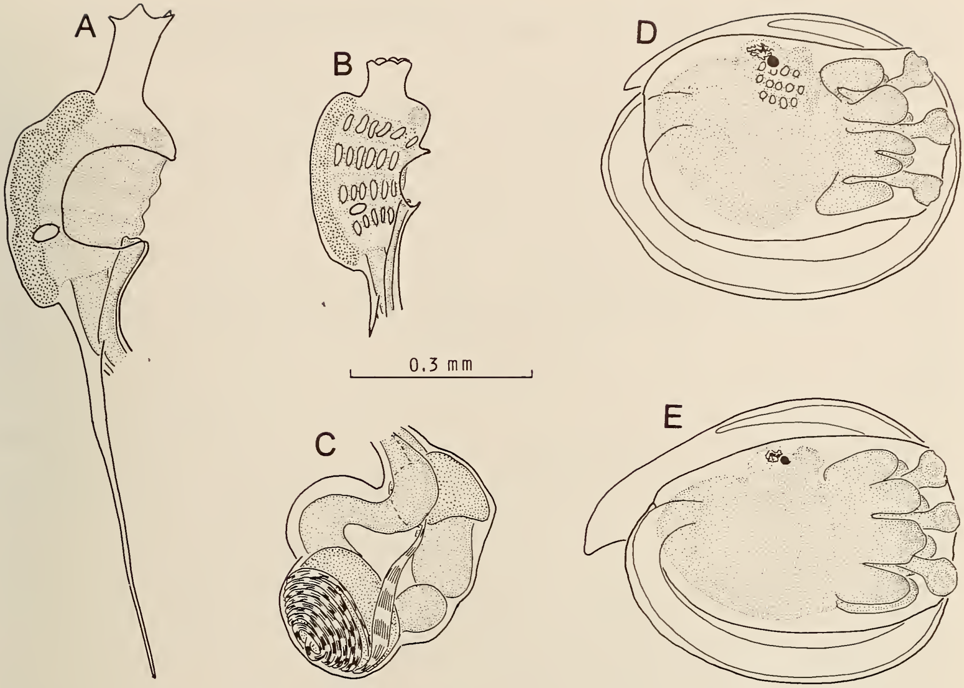

Fig. 25. *Didemnum leopardi* sp. nov. A. Thorax of a mature zooid. B. Thorax of a young zooid. C. Abdomen. D–E. Larvae.

are found throughout the tunic and especially in the zooids. The zooids are thus brown and small, less than 1 mm long, with their thoraces perpendicular to the colony surface and their abdomens folded under them. The cloacal channels are restricted to the thoracic level.

The zooids have a narrow, cylindrical oral siphon with six pointed lobes (Fig. 25A). The cloacal siphon is rather narrow in young zooids (Fig. 25B), and has anterior and posterior lips which form a kind of beak. In more mature zooids, the cloacal aperture is wider and these lips disappear (Fig. 25A).

The branchial sac has no anterior and posterior unperforated areas, and we counted six stigmata on each side in the first rows. The lateral thoracic organs are round, small, and located at the level of the third transverse vessel or fourth row of stigmata. A large area of the basal part of the thorax is unperforated. The retractor muscle (Fig. 25A) is at least equal in length to the thorax in mature zooids, and originates from the oesophageal peduncle.

The gut loop is short (Fig. 25C) with a small stomach and a comparatively large post-stomach. A spherical testis lobe protrudes from the posterior part of the gut loop (Fig. 25C). Its external hemisphere is covered by 7–9 coils of the sperm duct. The ovary appears and replaces the testis when it regresses.

The deeply pigmented larvae lie in the basal layer of the colony. The trunk is 0.5 mm long and has an ocellus, an otolith, three adhesive papillae and four pairs of anterior ampullae (Fig. 25E). In mature larvae (Fig. 25D), one of the anterior ampullae is sometimes partially divided and a vascular process appears on the left side of the trunk between the visceral mass and the ampullae.

The spicules (Fig. 29A) are of uniform stellate shape, the largest being 35 μm in diameter. The rays are fibrous and have blunt tips.

The leopard pigmentation of this species is characteristic, as is the kind of beak made by the anterior and posterior rims of the cloacal siphon in young zooids.

The colonies are inhabited by amphipods.

Didemnum mesembrinum F. Monniot sp. nov.

Figs 26, 29B

Material

Holotype. SAM–A25853, Knysna (34°04'S 23°03'E), intertidal. Collected by C. and F. Monniot, 12 Feb. 1996.

Other material. Several colonies. As above and from Fish Hoek, intertidal (Monniot coll.).

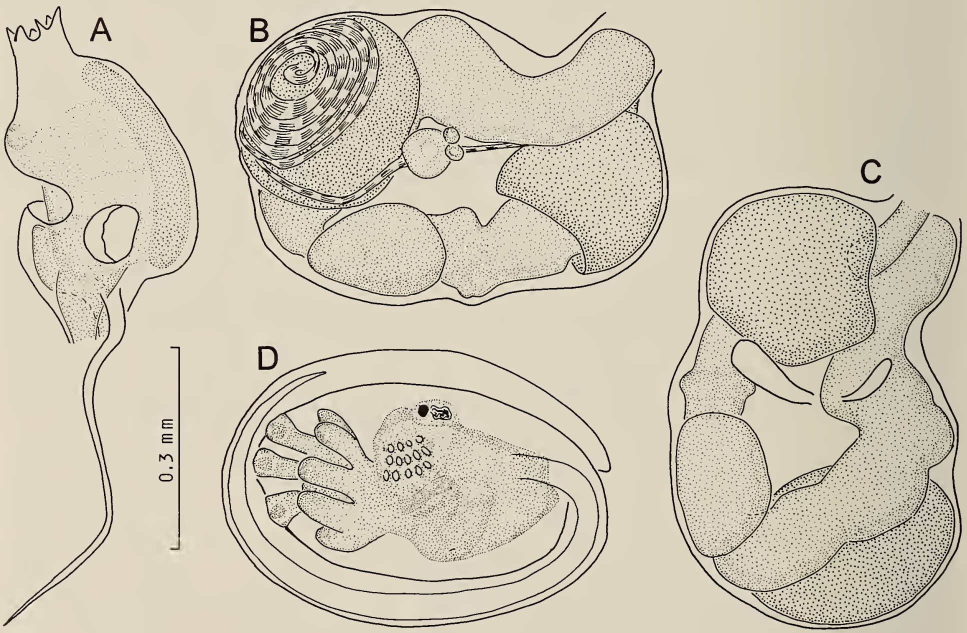

Fig. 26. *Didemnum mesembrinum* sp. nov. A. Thorax. B–C. Both sides of the abdomen. D. Larva.

Description

The colonies are large crusts, about 1 mm thick and reaching 100 mm across, covering all kinds of hard substrata. The colour in life is whitish or cream. As the spicules are not very abundant, the oral apertures and the roof of the cloacal channels merge into a darker marbled pattern. Some amphipods are burrowed in the tunic, which also includes algae, shell debris, bryozoans, polychaetes and sponges.

The zooids are very similar to those of *Didemnum millari*. The oral siphon is cylindrical with six lobes (Fig. 26A). The cloacal aperture is narrow, closed to a slit when the zooid is contracted. The lateral thoracic organs (Fig. 26A) protrude in the middle of the thoracic wall at the level of the third transverse vessel, sometimes spreading over two stigmata rows.

The long retractor muscle originates from the base of the thorax or the proximal part of the oesophageal peduncle (Fig. 26A). The abdomen (Fig. 26B) is larger than the thorax, and forms a narrow loop folded on itself with clearly distinguished segments (Fig. 26B, C). The large testis follicle (Fig. 26B) protrudes below the bottom of the gut loop, and its external pole is coiled with 6–9 turns of the sperm duct. The ovary develops between the testis and the stomach (Fig. 26).

The larvae (Fig. 26D) have an ovoid trunk, 0.46 mm in length, three-quarters of its perimeter encircled by the tail. The visceral mass is separated by a constriction from the three anterior adhesive papillae, which are surrounded by four pairs of elongated ampullae. The three rows of branchial stigmata are already pierced (Fig. 26D) and gut differentiation has commenced, but there is no bud. An ocellus and otolith are present.

The spicules (Fig. 29B) are small, their a maximum diameter being 25 μm. They consist of many blunt rays of similar length but slightly different thickness. The spicules in the tunic around the oral apertures are smaller than in other parts of the colony.

Remarks

This species is closely allied to *Didemnum stilense* sensu Millar (1955) (non *D. stilense* Michaelsen, 1934) for the anatomical characters of the zooids. Nevertheless *D. mesembrinum* sp. nov. differs in several points: the different appearance of the colonies, the lack of a mucous sheet at the colony surface, the sparser spicules and the cloacal channels that are visible from the surface. The shape of the spicules is completely different. No pigment inclusions were found in the basal layer of the colony, whereas they occur in the other species collected in the same locality.

Both species, *D. mesembrinum* and *D. millari* (the new name for *D. stilense* non Michaelsen, 1934; Millar, 1955, 1962), were probably combined as a single species by Millar, who remarked that he was not satisfied that all colonies belonged to the same species, noting that his identification was tentative.

Didemnum millari **F. Monniot sp. nov.**

Figs 27A–D, 29C

non *Didemnum stilense* Michaelsen, 1934: 146.
Didemnum stilense: Millar, 1955: 176 (*part.*).
?Didemnum stilense: Millar 1962: 164 (*part*).

Material

Holotype. SAM–A25854, Woolley's Pool, False Bay (34°08'S 18°26'E). Collected by C. Griffiths and C. and F. Monniot, 22 May 1994.

Other material. Several colonies. Wooley's Pool and Miller's Point, False Bay; Kommetjie (Griffiths and Monniot coll.). Common intertidally and subtidally.

Description

The cream-coloured colonies are thin, soft and no more than a few centimetres across. Numerous amphipods inhabit cavities in the colonies; their entrances are clearly visible in the surface as slits.

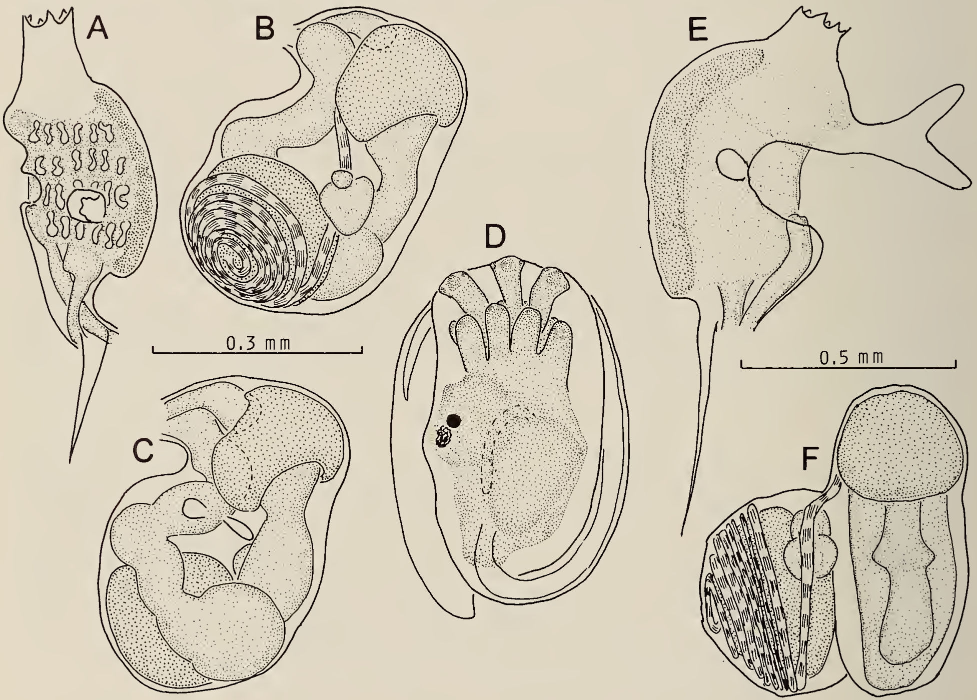

Fig. 27. A–D. *Didemnum millari* sp. nov. A. Zooid. B, C. Both sides of the abdomen. D. Larva. E–F. *Didemnum obscurum* sp. nov. E. Thorax. F. Abdomen.

The colonies encrust all kinds of material: rocks, shells, sponges, bryozoans and algae. The colony surface is either smooth or raised in tiny spots as the oral siphons protrude when the animal is contracted. The spicules are irregularly distributed and sometimes give the colony surface a thinly reticulated appearance under magnification. A very thin layer of tunic without spicules or vacuolar cells covers the surface of the colonies, giving them a shiny appearance. Orange inclusions are irregularly scattered within the basal part of the tunic. The cloacal channels are restricted to the thoracic region.

The six oral lobes of the zooids are pointed (Fig. 27A). The thorax is smaller than the abdomen, always contracted, and has a low, small cloacal aperture without languet. There are six stigmata in each half row. The lateral thoracic organs are circular, protruding, often large, extending above the third row of stigmata, and located in the middle of the thorax width (Fig. 27A). The retractor muscle separates from the oesophageal peduncle (Fig. 27A).

The gut loop (Fig. 27C) is folded back on itself. The single testis vesicle (Fig. 27B) is covered with 6–9 coils of the sperm duct and lies on the bottom of the gut loop, with the ovary on its side.

The larvae are small (Fig. 27D), 460 μm in trunk length, with three diverging narrow adhesive papillae and four pairs of lateral digitiform ampullae. They are not gemmiparous.

The spicules (Fig. 29C) are stellate with few conical pointed rays, the largest being 30 μm in diameter.

Remarks

This description corresponds relatively well with what Millar (1955, 1962) tentatively identified as *D. stilense* Michaelsen, 1934, from the same geographic area. However, our colonies do not correspond with the original description by Michaelsen (1934), who stated that his species had no spicules in the surface layer of the colony but possessed large bladder cells, and spicules 'with very numerous short conical spines'. In addition Michaelsen gave the colony thickness as 9 mm, this being quite different to the thin crusts of *D. millari.*

Didemnum molle (Herdman, 1886)

Diplosomoides molle Herdman, 1886: 310.
Didemnum molle: see Monniot, F., 1994: 316, fig. 10.

*M*aterial

Several colonies, Sodwana Bay, KwaZulu-Natal, 15 m (Schleyer coll.).

Distribution

This urn-shaped species is very common in all tropical areas of the Indian and western Pacific oceans. Its presence in KwaZulu-Natal probably represents the southernmost distribution of the species. *Didemnum molle* contains abundant mucus and unicellular symbiotic algae.

Didemnum ?obscurum F. Monniot, 1969

Figs 3B, 27E, F, 29D

Didemnum obscurum Monniot, F., 1969: 453; 1994: 319. Monniot, C. & Monniot, F., 1997: 1626.

Material

Two colonies, Sodwana Bay, KwaZulu-Natal, 15 m (Schleyer coll.).

Description

The two colonies from different stations are encrustations, 2–4 mm thick with a smooth surface. The common cloacal openings are stellate. The colony surface is very smooth and olive green to gold. The narrow cloacal channels are limited to the thoracic level. The tunic is tough. The spicules are limited to a thin layer at the colony surface and another at the interface with the substratum. The tunic is filled with large vacuolar cells throughout its thickness. It is brown in formalin.

The zooids only occupy the upper layer of the colony. They are dark brown in formalin. The oral siphon has six short sharp lobes (Fig. 27E). The cloacal languet (Fig. 27E) is very variable in size. It is wide around the common cloacal aperture and has two lobes and a transverse musculature. Elsewhere, the languet is small, T-shaped or simple. It is always fragile and difficult to extract from the tunic. The lateral thoracic organs are round and protrude at the rim of the body wall facing the second transverse vessel (Fig. 27E). The branchial sac, dark brown in formalin, has 8–10 stigmata per side in the first row. The retractor muscle is attached at the anterior part of the short waist (Fig. 27E).

The gut loop is flat (Fig. 27F). The single testis vesicle is particularly large, filling almost the whole abdomen (Fig. 27F). The sperm duct has 8–9 coils. The ovary develops simultaneously with the testis. Only one very young embryo was found in a single colony.

The spicules (Fig. 29D) are rather uniform in size and consist of numerous sharp rays.

Remarks and distribution

Didemnum obscurum Monniot, F., 1969, was described from Dakar and also collected at Bahrain, the Seychelles Islands and New Caledonia. The samples from KwaZulu-Natal do not contain larvae, so the identification remains uncertain. It is based on the similarity of the spicule shape and distribution, the dark pigment and the zooid anatomy.

Didemnum psammathodes (Sluiter, 1895)

Leptoclinum psammathodes Sluiter, 1895: 11.
Didemnum psammathodes: for synonymy see Monniot, F., 1994: 324.

Material

One colony. Thompson's Pool, near Ballito, KwaZulu-Natal (Griffiths coll.).

Description

A very small piece of colony was collected at low tide. The tunic is filled with faecal pellets, mixed with sparse spicules, except around the oral aperture, where spicules are more abundant. The zooids are similarly arranged as in colonies from other oceans (Monniot, F. 1983).

Didemnum psammathodes is widely distributed in the Atlantic Ocean from the Caribbean islands to Brazil (Rocha & Monniot 1995), in the western and central Pacific Ocean and the whole tropical Indian Ocean south to KwaZulu-Natal.

Didemnum rodriguesi Rocha & F Monniot, 1993

Fig. 3C

Didemunum rodriguesi Rocha & Monniot, F., 1993: 261, figs 1–2. Monniot, F., 1994: 326, pl. 5A.

Material

Several colonies. Sodwana Bay, KwaZulu-Natal, intertidal to 22 m (Schleyer coll.).

Description

Underwater, the colonies are orange with common cloacal apertures on the top of swellings, circled with white. Under magnification, the colony surface has the thin reticulated pattern of the spicular arrangment observed in Atlantic and Pacific specimens. The spicules, zooids and larval anatomy are universally identical.

The presence of *Didemnum rodriguesi* in KwaZulu-Natal, recorded previously only from Brazil and New Caledonia, confirms that it has a worldwide tropical distribution.

This species can easily be confused with *Didemnum moseleyi* in the absence of larvae.

Polysyncraton ?aspiculatum Tokioka, 1949

Figs 3D, 28, 29E

Didemnum (Polysyncraton) aspiculatum Tokioka, 1949: 2, pl. 2 (figs 1–3). Kott, 1962: 301, figs 36–38; 1975. Nishikawa, 1990: 111.

Material

Several colonies. Sodwana Bay, KwaZulu-Natal, 14–15 m (Schleyer coll.). Djibouti, 5 m (Monniot coll.). Philippines, south of Maricaban Island (13°38.39’N 120°55.86’E), 16 m (CRRF coll.).

Description

The colonies from KwaZulu-Natal are pure white, thick crusts of a soft consistency. The spicules may be dense throughout the colonies, or limited to the surface and basal layers. Large cloacal channels are apparent from the surface as yellowish transparent lines delimiting irregular masses on the edges of which the oral siphons open.

The general structure of specimens from Djibouti is similar, but with fewer spicules and more pigment cells, giving the colonies a light brown colour. The network of the cloacal channels is the same. The only difference in colonies

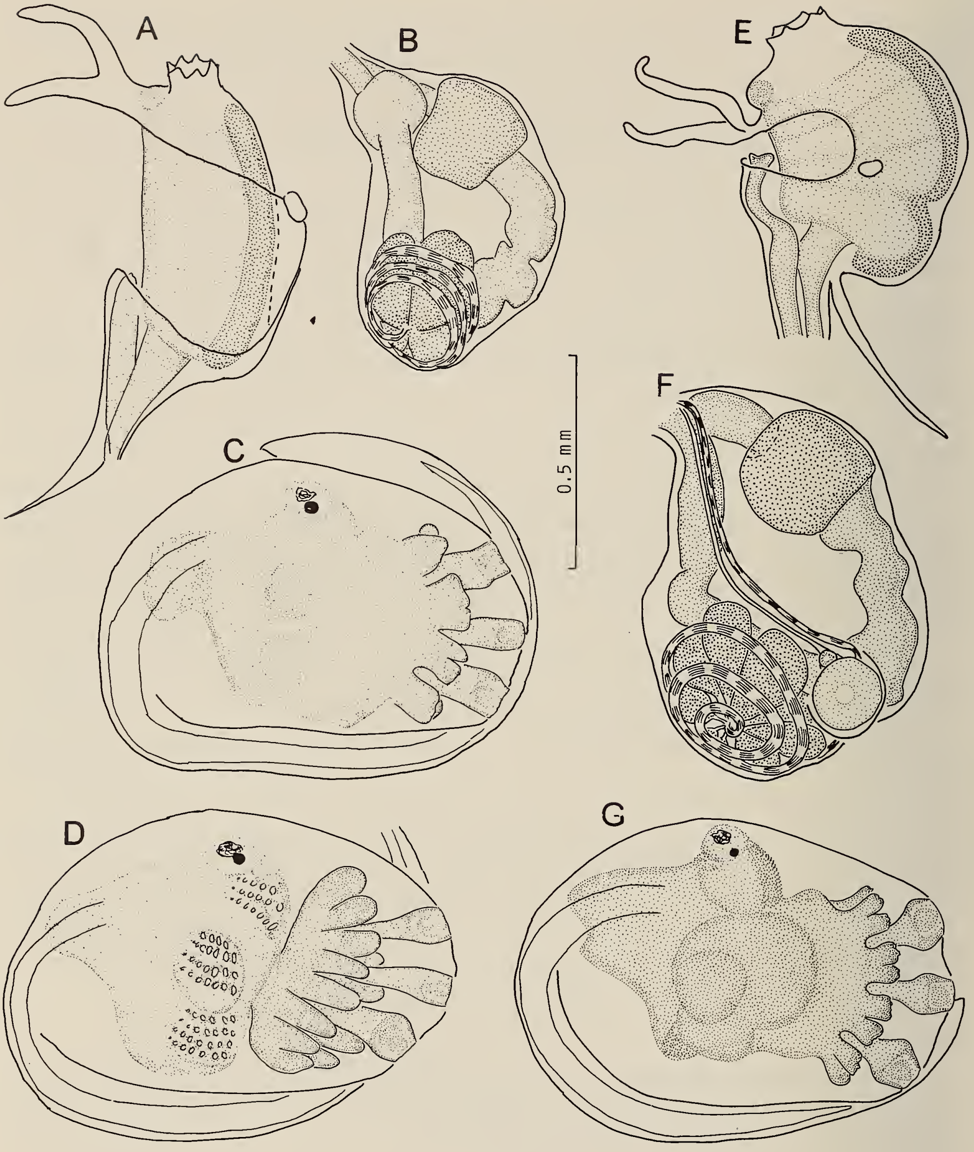

Fig. 28. *Polysyncraton aspiculatum*. A–D. Specimens from South Africa. A. Thorax. B. Abdomen. C–D. Larvae. E–G. Specimens from Djibouti. E. Thorax. F. Abdomen. G. Larva.

from the Philippines is their darker brown colour caused by a greater abundance of pigment cells in the tunic and zooids, and the absence of spicules.

The zooids are similar in structure to material from all of the above regions, as well as to the type specimen loaned from the Seto Marine Biological Laboratory.

The oral siphon is short with six lobes (Fig. 28A, E). The cloacal aperture may be very wide in relaxed zooids, exposing a large part of the branchial sac (Fig. 28A). The cloacal languet varies in shape according to its proximity to the common cloacal aperture. Close to it, it is always large, with two thin, long lobes (Fig. 28A, E), but these may be thicker and shorter elsewhere. The round lateral thoracic organs are located over the second row of stigmata or over the second transverse vessel. The branchial sac has ten stigmata on each side in the three first rows.

The retractor muscle originates in the anterior from the oesophageal peduncle (Fig. 28A, E).

The gut loop is wide open (Fig. 28B, F). The stomach is spherical and relatively small. The testis vesicles are arranged in a rosette of 5–10 elongated lobes, in the gut loop (Fig. 28B, F). The sperm duct is coiled in 3–5 loose turns. The ovary lies inside the last turn of the sperm duct and the oviduct follows the straight ascending part of the rectum.

Larvae were only present in colonies collected in KwaZulu-Natal, Djibouti and the Philippines, not Japan. They are large (Fig. 28C, D, G), with a trunk about 1 mm long and half encircled by the tail. Mature larvae have eight pairs of elongated ampullae on either side of the three adhesive papillae (Fig. 28D), resulting from the division of four pairs of ampullae in less developed tadpoles (Fig. 28C). An ocellus and an otolith are present. One bud develops on each side of the visceral mass.

The spicules (Fig. 29E) are about 30 μm in diameter; they consist of needles gathered in numerous rays to form balls. Their size varies according to their density within the colonies. They are very small and located within the lateral thoracic organs in the type colony described by Tokioka (1949). In colonies from Djibouti, the spicules are only present in tracks at the colony surface. In the specimens from KwaZulu-Natal, the spicules are sparse in some colonies and more abundant in others (Fig. 29E).

Remarks and distribution

The identification of the South African colonies would have been very speculative if the material had not been compared with samples from other areas. The colour and the density of the spicules, being variable within the same geographical region, do not allow us to separate the material into different species. The type specimen and other colonies collected by Nishikawa were examined but did not contain larvae.

Millar (1962) described *Polysyncraton magnilarvum* from a colony collected in KwaZulu-Natal. He recorded it as having a greyish-pink colour, soft consistency and few spicules. The description corresponds well with Millar's type specimen in the South African Museum. This confirms that *Polysyncraton magnilarvum* is different from *P. aspiculatum* Tokioka, 1949, in having larger spicules with fewer rays and larger larvae.

The distribution of *P. aspiculatum* is widespread, ranging from Japan to the Philippines, southern Australia, Djibouti and South Africa, if the material attributed to it consists of a single species.

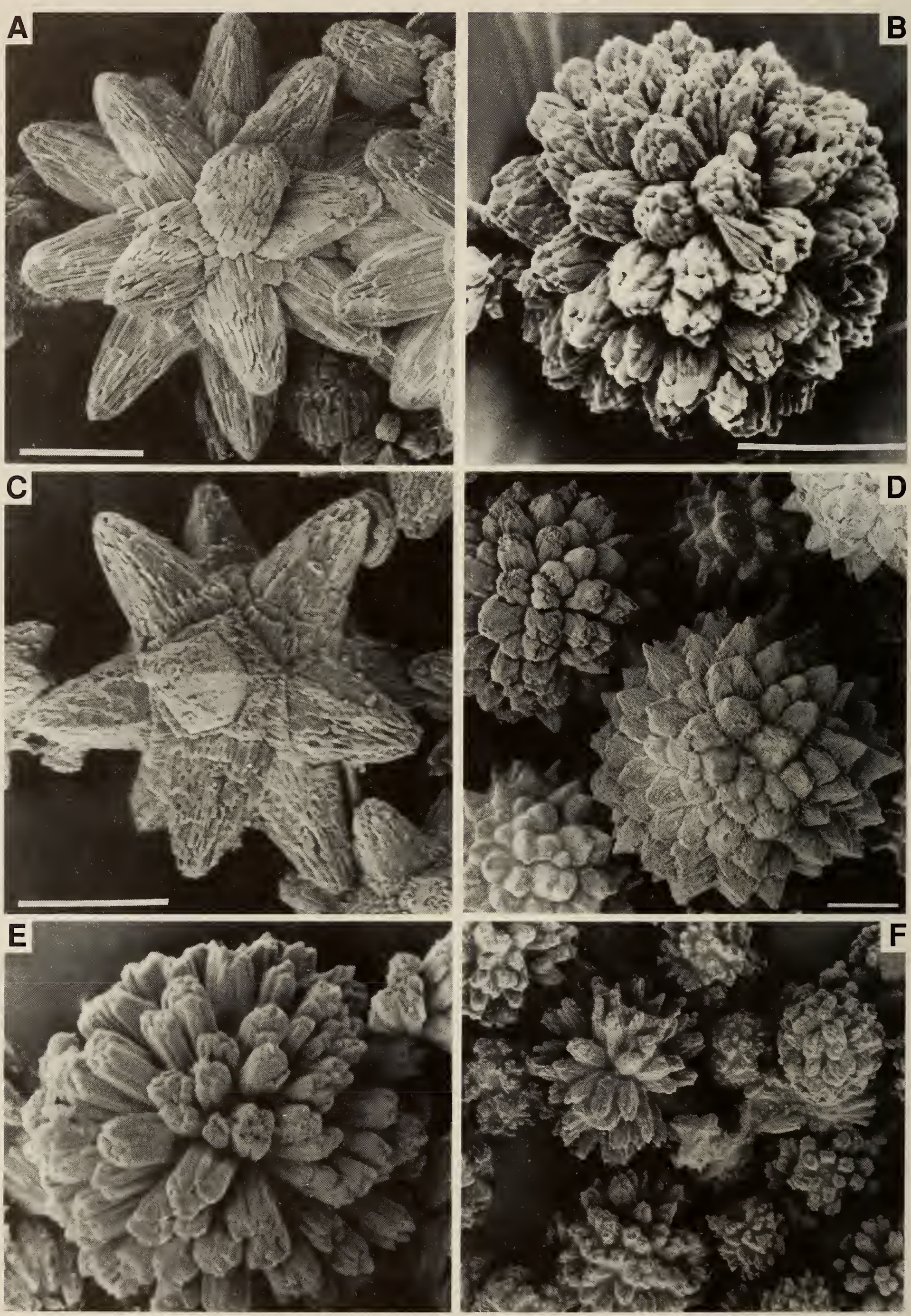

Fig. 29. Spicules. A. *Didemnum leopardi* sp. nov. B. *Didemnum mesembrinum* sp. nov. C. *Didemnum millari* sp. nov. D. *Didemnum obscurum*. E. *Polysyncraton aspiculatum*. F. *Lissoclinum bilobatum*. Scale bars = 10 μm.

Polysyncraton millepore Vasseur, 1968
Fig. 3E

Polysyncraton millepore Vasseur, 1968: 917. Monniot, F. & Monniot, C., 1999: figs 7B, 8A–D, pl. 1D, E.

Material

Several colonies, Sodwana Bay, KwaZulu-Natal, 8–22 m (Schleyer coll.).

Description

The colonies are large, convoluted sheets, with a smooth surface irregularly stained in tan and dark brown. The general consistency is hard, as the spicules are very densely packed throughout the tunic thickness.

The species has been recorded from Madagascar, Mozambique, and KwaZulu-Natal in South Africa, but not further south.

Atriolum marsupialis F. Monniot, 1989
Fig. 30C

Atriolum marsupialis Monniot, F., 1989: 674, text-fig.1, pl. 1A.

Material

Two colonies. Sodwana Bay, KwaZulu-Natal, 15 m, on *Polycarpa* (Schleyer coll.); Ibo Island, Mozambique, 10 m (Monniot coll.).

Description

The largest colony is 25 mm across and 3 mm thick. The colour is yellowish. The tunic is soft but resistant, containing few spicules in a single layer at the colony surface, sometimes gathered in white trails in the surface layer, which has small, irregular, erect papillae. Tracks of orange pigment and dark pigment cells are present in the basal tunic. Zooids and larvae are colourless. The cloacal channels are narrow.

The oral siphon is long compared to the zooid size, and without lobes at its rim. It is closed by a strong basal sphincter. The cloacal siphon is located at the postero-dorsal angle of the thorax. It has a peculiar shape: a sphincter encircles the cylindrical tube, the free extremity of which is divided in two unequal lips with the posterior lip being larger and curved in a kind of spoon. Both lips are edged with a crescent of transverse muscle fibres. The thorax is wide and almost square. Its wall has about ten longitudinal fibres on each side that are regularly spaced and not ramified. The lateral thoracic organs are located above the third transverse vessel in the middle of each side.

The branchial sac has four rows of 14 stigmata per side behind an unperforated area of one stigma length. An incubatory pouch with a narrow peduncle arises in the posterior part of the thorax against the oesophageal peduncle. There is no retractor muscle.

The waist is narrow and the abdomen is folded under the thorax. The gut loop is made of a narrow cylindrical oesophagus, a spherical stomach with a smooth wall, a conical post-stomach and an oval mid-intestine separated from the rectum by a constriction. The anus opens at the level of the third row of stigmata.

Five to seven testis vesicles in a rosette are covered by 7–8 coils of the sperm duct. The ovary develops against the testis. Two or three vascular processes arise from the centre of the gut loop on the side opposite the gonads.

The larvae (Fig. 30C) are brooded in the basal layer of the tunic, but only young, empty brood pouches were found attached to the zooids. The trunk is 0.65 mm long and spherical with the tail encircling three-quarters of the perimeter. The three adhesive papillae are thick, in a line, with four large, rounded ampullae on each side. The papillae and vesicles are separated from the visceral mass by a constriction. The larval branchial sac is already developed, as are the different parts of the digestive tract. A vascular process is differentiated on the right side of the larva, but there are no buds. The spicules are stellate, with numerous sharp rays.

Remarks and distribution

The African samples correspond exactly to *Atriolum marsupialis*, as described from New Caledonia. Only two other species of *Atriolum* have been described: *Atriolum quadratum* Monniot, F. & Monniot, C., 1996, from the western Pacific at Chuuk Island, and recently found again in Mozambique; and *Atriolum robustum* Kott, 1983, from the north of Australia but also present in New Caledonia (Monniot, F. 1990), Madagascar (Millar 1988), Mayotte (Comoros islands) and Mauritius (Lafargue & Vasseur 1989).

Lissoclinum bilobatum Millar, 1955

Figs 29F, 30A, B

Lissoclinum bilobatum Millar, 1955: 180, fig. 11. Plante & Vasseur, 1966: 146, pl. 2 (fig. 11).

Material

Several colonies. Thompson's Pool, near Ballito, KwaZulu-Natal (Griffiths coll.); Port Elizabeth, intertidal (Monniot coll.).

Description

The colonies are thin and pink or white encrustations of a soft consistency. The colony surface is smooth. The oral apertures are stellate. The cloacal channels are very wide.

The zooids have a short oral siphon (Fig. 30A). The wide cloacal aperture uncovers a large part of the branchial sac. A round languet is present (Fig. 30A) but is sometimes is very small and barely visible. The round, protruding lateral organs are located at the level of the second transverse vessel. There are eight stigmata in the first and second half rows. The retractor muscle is absent. The abdomen is folded under the thorax. The gut loop is very narrow and contains a large, clear vesicle (Fig. 30B). The testis lies over the intestine and has two longitudinal lobes (Fig. 30B). The sperm duct is straight and enlarged at its start when the testis is fully developed.

Some larvae were present in a pink colony collected at Port Elizabeth. The trunk is 0.65 mm long and entirely covered with large pigment cells, which are dark brown in formalin. All larvae are immature and only have three adhesive papillae and an indication of four pairs of lateral ampullae.

The spicules (Fig. 29F) are generally small, 20 μm in diameter, but there are a few larger ones up to 35 μm. They are balls made of numerous rays of parallel needles which are rather irregularly spaced.

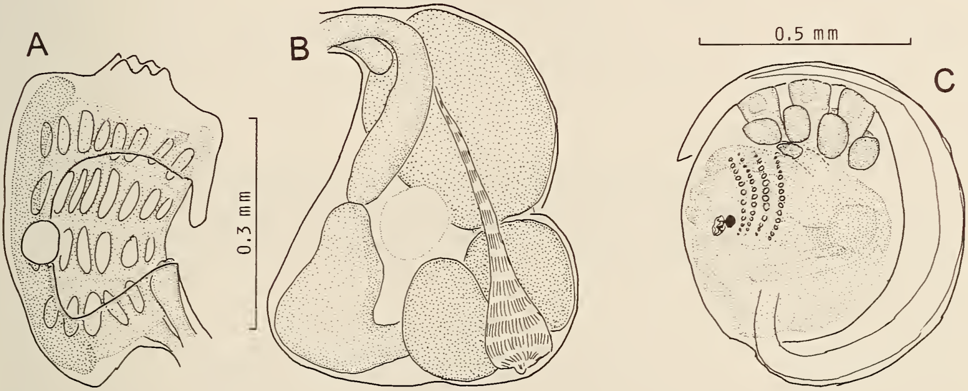

Fig. 30. A–B. *Lissoclinum bilobatum*. A. Thorax. B. Abdomen. C. *Atriolum marsupialis*. Larva.

Remarks and distribution

It was difficult to identify this species, as Millar's (1955) type could not be found at the British Museum. The description corresponds well with our specimen as well as the spicule size. Millar did not mention the cloacal languet or retractor muscle and they are absent in his figure.

This *Lissoclinum* species is closely allied to the Atlantic *Lissoclinum fragile* (Van Name, 1902) as described by Monniot, F. (1983). The zooids and spicules are similar. In the absence of mature larvae in the South African colonies, we prefer to retain Millar's name, *L. bilobatum*. Further collections of colonies with larvae would perhaps allow us to synonymize both species.

The species distribution is presently restricted to Madagascar and the east coast of South Africa.

Lissoclinum bistratum (Sluiter, 1905)

Leptoclinum bistratum Sluiter, 1905: 18, pl. 2 (fig. 10).
For detailed synonymies see Kott, 1982: 112; Monniot, F., 1992: 566, text-fig. 1, pl. 1A.

Material

Several colonies. Sodwana Bay, KwaZulu-Natal, 19 m (Schleyer coll.).

Distribution

This species contains abundant symbiotic unicellular algae. It is very common in the western tropical Pacific Ocean and in all the tropical Indian Ocean from the extreme north to KwaZulu-Natal.

Diplosoma listerianum (Milne-Edwards, 1841)

Leptoclinum listerianum Milne-Edwards, 1841: 300.

For a description and synonymy see Lafargue, 1968: 406, fig. 9; Monniot, F., 1983: 41. Monniot, C. & Monniot, F., 1987: 59.

Material

Several colonies. In all harbours from Saldanha Bay to Port Elizabeth.

Remarks and distribution

This European species has invaded numerous harbours in temperate and tropical areas in the Atlantic, Pacific and Indian oceans. It is commonly found on ship hulls and grows in thin soft sheets or thicker pads. The colony colour varies from white to dark grey.

Diplosoma virens (Hartmeyer, 1909)

Leptoclinum virens Hartmeyer, 1909: 1456. (nom. nov. for *Diplosoma viride* Herdman, 1906.)

For a detailed synonymy see Monniot, F. & Monniot, C., 1996: 170.

Material

Several colonies. Rocky Bay, KwaZulu-Natal, 2 m (M. E. Aken coll.).

Remarks and distribution

The zooids and larvae are identical to western Pacific samples. All colonies have symbiotic algae. This species is widely distributed in shallow tropical waters in the Pacific and Indian oceans.

Family **Cionidae**

Ciona intestinalis (Linné, 1767)

Ciona intestinalis see Berrill, 1950: 131, figs 40–41. Hoshino & Nishikawa, 1985, fig. 1A–C, 2, 4.

Material

Several colonies. Cape Town; Hout Bay; Port Elizabeth (Griffiths and Monniot coll.).

Remarks and distribution

Ciona intestinalis originated in the northern Atlantic Ocean, but has invaded harbours throughout temperate and subtropical climes.

This species was recorded by Millar (1955) in Durban Harbour and by Millar (1962) in Saldanha Bay. We collected this species in several harbours such as Saldanha Bay, Cape Town, Hout Bay and Port Elizabeth. The specimens from Hout Bay have short siphons circled by a thick rod of tunic that is somewhat tuberculated. This morphology is sometimes encountered in European harbours. On the contrary the red form of this species, which is occasionally found in Europe, has not been recorded in South Africa.

Family **Perophoridae**

Ecteinascidia modesta C. Monniot sp. nov.

Fig. 31

Material

Holotype. SAM–A25855, Knysna Estuary (34°04'S 23°03'E), collected by C. and F. Monniot, Feb. 1996.

Other material. Several colonies. Locality details as above.

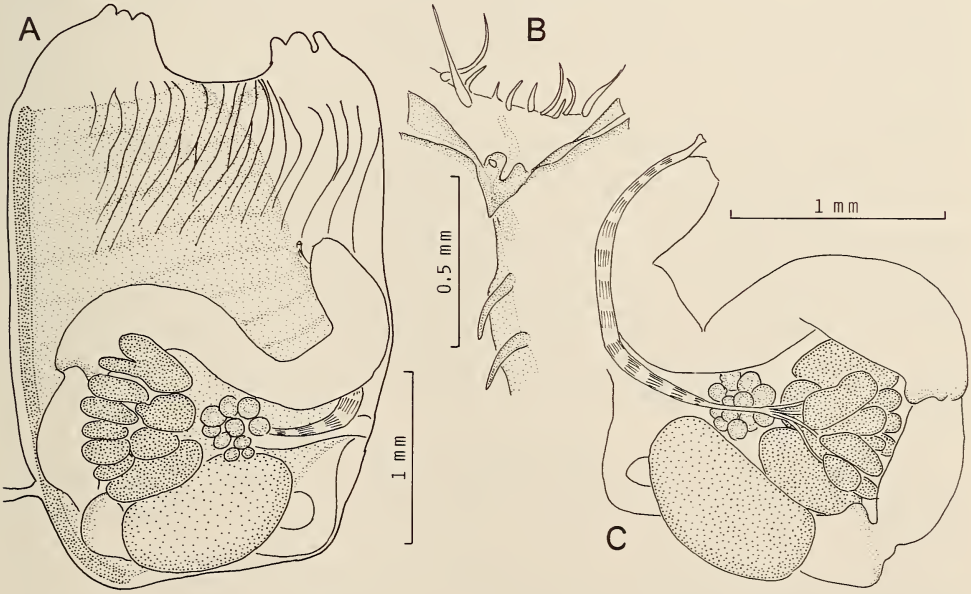

Fig. 31. *Ecteinascidia modesta* sp. nov. A. Left side of body. B. Dorsal area. C. Gut and gonads.

Description

The colonies of small zooids (3 mm) are colourless and live on bryozoan crusts. The individuals are isolated, sometimes have a short peduncle, and are united by a network of stolons. The oral siphon is on the top, and the cloacal siphon somewhat lateral. Both apertures are encircled by six flat lobes indented by deep clefts. The musculature (Fig. 31A) comprises about 20 thin oblique and regularly spaced roughly parallel ribbons. They originate from a region on each side of the body that runs from below the oral siphon to below the cloacal siphon and includes the intersiphonal space (Fig. 31A). About 30 oral tentacles in three orders of size do not regularly alternate in a ring at mid-length of the oval siphon (Fig. 31B). The prepharyngeal groove has two inequal rims, the anterior higher. The urn-shaped dorsal tubercle opens through a round hole (Fig. 31B). The dorsal lamina consists of languets united by a basal membrane which is half the height of a languet (Fig. 31B).

The branchial sac has 11 rows of stigmata and 12–13 generally entire longitudinal vessels on each side. About 25 stigmata, consequently two per mesh, are counted in a row. We did not observe divisions of stigmata or of rows of stigmata. The posterior row is somewhat irregular. The oesophagus enters the posterior side of an oval stomach (Fig. 31C). The intestine is divided into three parts by constrictions; it has no caeca. The simple anus opens between the fifth and sixth row of stigmata.

The ovary contains numerous poorly developed oocytes. The testis (Fig. 31C) is ventral to the ovary and consists of elongated lobes that protrude just beyond the external edge of the gut. The wide sperm duct opens through a papilla adjacent to the anus. The oviduct extends to the right side of the body. The ovary was not mature and no larvae were found.

Remarks

This species is characterized by its small number of stigmata rows (11) and oblique musculature. It differs from *E. multistigmata* (= *Perophora multistigmata* Kott, 1952) from Queensland, which has fewer stigmata rows (eight), a musculature with numerous fibres more complex in origin and a single testis with few lobes. It is closely allied to *E. bandaensis* Millar, 1975, from Indonesia, Philippines, Madagascar and Mozambique (Monniot, F. & Monniot, C. 2001), a species with similar musculature but 16 stigmata rows, a globular stomach and a testis made of very numerous small lobes surrounding the ovary. In addition, *E. bandaensis* has an opaque tunic with a red line encircling the siphons.

Ecteinascidia modesta superficially resembles the small northern Atlantic species *E. minuta* Berrill, 1932, and *E. herdmani* (Lahille, 1887), but the gut loop is narrower and the stigmata more numerous in both those species.

The species name *Ecteinascidia modesta* refers to its very discrete presence, making it difficult to notice in the field.

Ecteinascidia thurstoni Herdman, 1891

Ecteinascidia thurstoni, Monniot, C. & Monniot, F., 1997: 1630, fig. 4.
Ecteinascidia hedwigiae Michaelsen, 1918: 60, pl. 1 (figs 1–2).

Material

One colony, Isipingo, KwaZulu-Natal (Griffiths coll.); Knysna, young specimens (Monniot coll.).

Distribution

This species was described from material collected in Sri Lanka and later from specimens collected in Western Australia, the Arabian Gulf, Djibouti, Tanzania and Mozambique. It is the only record of the family Perophoridae in South Africa that has been previously described.

Family **Corellidae**

Corella eumyota Traustedt, 1882

Corella eumyota Traustedt, 1882: 17, pl. 4 (figs 2, 3), pl. 5 (figs 13, 14).

Material

Two specimens. Saldanha Bay Harbour (Monniot coll.).

Remarks and distribution

This species was recorded for the first time in Cape Town by Sluiter (1898*a*) and found again by Michaelsen (1934) and Millar (1955, 1962). It inhabits seas around Antarctica, Tasmania, South Australia, and the southern part of South America. In the Atlantic Ocean it was recorded off Tristan da Cunha by Millar (1967*b*), and Namibia by Michaelsen (1915) and Turon (1988).

The adult South African specimens are small (20 mm) compared to individuals from the Antarctic, which attain 100 mm. The branchial sac is less developed with fewer coils of stigmata. The development of the branchial sac and the gut in this species varies according to environmental conditions (Monniot, C. & Monniot, F. 1983). Numerous eggs were present in the cloacal cavity in samples from New Zealand, and Lambert *et al.* (1995) described brooded larvae.

Family **Ascidiidae**

Ascidia canaliculata Heller, 1878, part of *A. sydneiensis* aut. mult.

Fig. 32

Ascidia canaliculata Heller, 1878: 84, pl. 1 (fig. 1). Sluiter, 1898*a*: 41, pl. 5 (figs 15–18). Michaelsen, 1921: 5.
Phallusia canaliculata: Hartmeyer, 1911: 576, pl. 57 (figs 13–14).
Phallusia longitubis Traustedt, 1882: 283.

Material

Several specimens. Fish Hoek, False Bay (Monniot coll.).

Description

Ascidia canaliculata is closely allied to *A. sydneiensis* Stimpson, 1855. Both species were synonymized by Van Name (1921). They have in common large, grooved siphons with digitate lobes and a characteristic transverse musculature limited to the right side of the body (Fig. 32B). The musculature consists of two ribbons of parallel fibres, one ventral and one dorsal. These ribbons are linked by very thin fibres which become visible when stained (Fig. 32B). The gut always has a bulbous widening of the posterior intestine filled with sediment (Fig. 32A) even in very young individuals.

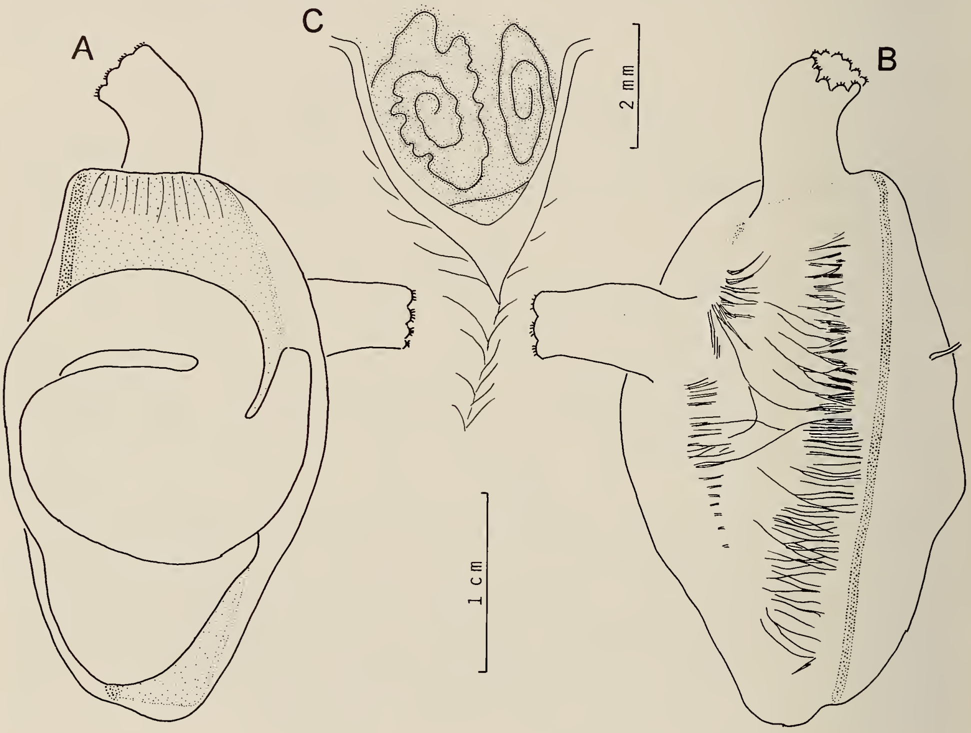

Fig. 32. *Ascidia canaliculata*. A. Left side of body. B. Muscles on the right side. C. Dorsal tubercle.

Remarks and distribution

The only distinguishing characteristic of the species is the structure of the dorsal tubercle (Fig. 32C). In all the Atlantic, South African and Mozambican populations this has the shape of a 'V' that is open anteriorly and has horns curled interiorly. It is not regular in pattern but rather undulated (Fig. 32C). In *A. sydneiensis*, a Pacific Ocean species, the dorsal tubercle is pierced by several openings. Authors who have examined both species consider them distinct (Sluiter 1898*a*; Hartmeyer 1911), except for Millar (1955) who was doubtful.

Ascidia sydneiensis is somewhat variable in the Pacific. Tokioka (1953) recognized three subspecies in Japan: *A. sydneiensis sydneiensis*, which has a simple dorsal tubercle; and *A. sydneiensis divisa* and *A. sydneiensis samea*, whose divided dorsal tubercles differ. Nishikawa (1991) examined the same material and showed that the position of the gut is variable and that the dorsal tubercle is simple in small specimens before becoming more complex with growth. He thus did not recognize Tokioka's subspecies. An undulated opening is not mentioned in any description of *A. sydneiensis,* the shape usually being described as a 'C' open to the left side with horns slightly curved.

Although all specimens from the Atlantic Ocean, South Africa and Mozambique correspond to *A. canaliculata*, those from the western coast of Australia have complex dorsal tubercles (Kott 1985) and correspond to *A. sydneiensis*. In Mauritius, Vasseur (1967) described *A. sydneiensis* as having simple or divided dorsal tubercles; he found Tokioka's three variant morphologies but refused to use the subspecies. In Sri Lanka, Herdman (1906) described small specimens 24 mm in length, and these had a simple dorsal tubercle.

Traustedt & Weltner (1894) recorded the presence of *Phallusia longitubis* in the Indian Ocean without providing a description.

Taking this disparity of characters into account and noting the limits of variability in *A. sydneiensis* after all, we believe that *A. canaliculata* and *A. sydneiensis* are different (vicariant) species.

Ascidia caudata Heller, 1878

Figs 3F, 33

Ascidia caudata Heller, 1878: 85, pl. 2 (fig. 2).

Material

Several specimens. False Bay, low tide (Monniot coll.).

Description

Ascidia caudata has not been recorded in South Africa in over a century. This is rather surprising as it is a common species at 1–2 m depth and attains a size of 25 cm. It inhabits narrow crevices and the underside of large boulders where there is a space of some centimetres between the rock and the sediment. The ascidians are attached to the rock on their whole left side, including the siphons. The right side of the body and the siphons are generally covered with large shell fragments and gravel. The long siphons diverge and they may be 15 cm apart. The colour of the tunic surface varies from yellow to brown or almost black, according to the distance from the edge of the rock, the pigment being light-induced. The remainder of the tunic is pale grey or yellowish.

In life the body wall is sulphur yellow, pigmented by blood cells. When fixed these cells turn black (as in many Ascidiidae rich in vanadocytes). The tunic is thin on the left side of the body but forms a pad that protrudes internally between the posterior intestine and the rectum. The siphons do not show lobes. The muscles are strong on the right side, mostly transverse with some fibres issuing from the cloacal siphon in the anterior part of the body. The muscles are dense over the gut, almost joined, but more diffuse posteriorly. The left side of the body wall and the tip of the siphons are devoid of musculature.

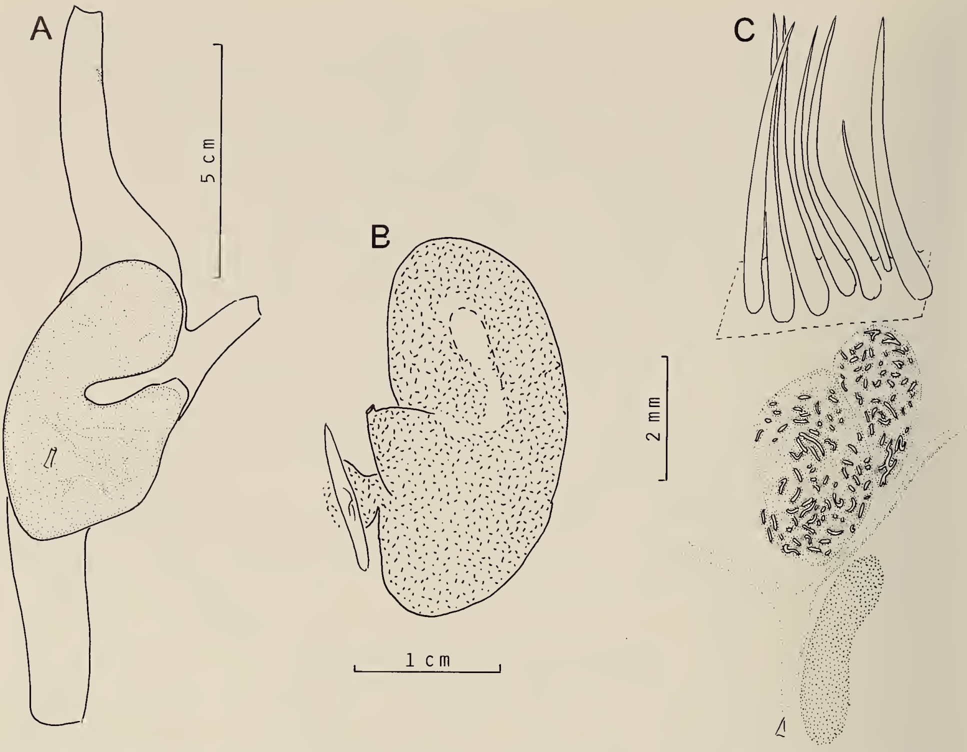

Fig. 33. *Ascidia caudata.* A. Left side of body of a large specimen. B. Testis on the gut of a small specimen. C. Dorsal tubercle.

More than a hundred oral tentacles are located on a thin high crest in large specimens. They are 4 mm long, almost all equal in size (Fig. 33C) and form a kind of comb that closes the oral aperture. The prepharyngeal band has two equal rims. The dorsal tubercle (Fig. 33C) consists of two masses of tissue pierced by numerous holes. The neural ganglion is close to the dorsal tubercle. The low dorsal lamina has a smooth margin, which is stiffly delineated only on the left side. The oesophagus entrance is located anteriorly to the bottom of the branchial sac. It is large, sometimes smooth or with protruding crests. On the right side of the branchial sac, the extremities of the transverse vessels form hooks linked by a membrane. The branchial internal longitudinal vessels only bear large papillae. The vessels are close to each other in small specimens (7 cm) and the square meshes contain, on average, three small stigmata. In large individuals, the meshes lengthen transversally and may have seven stigmata. The transverse vessels are wide on the external side of the branchial sac; they are linked together and form an irregular network covering at least half of the branchial surface, even in young specimens. The fragile branchial tissue is linked to the body wall by numerous short connections. The cloacal cavity is not spacious.

The gut describes a double loop (Fig. 33A, B). The exact path of the digestive tract is difficult to follow even in small specimens, as the visceral mass is rendered opaque by testis vesicles (Fig. 33B). The ovary is also hidden. The anus is very small, has a plain margin and opens in the centre of the visceral mass (Fig. 33B).

Distribution

Ascidia caudata has only been recorded from the Cape Peninsula, South Africa.

Ascidia incrassata Heller, 1878

Fig. 34

Ascidia incrassata Heller, 1878: 88, pl. 2 (fig. 8). Michaelsen, 1934: 154.

Material

Several specimens. Miller's Point, False Bay, 2–10 m. (Griffiths coll.); Saldanha Bay Harbour (Monniot coll.).

Description

The largest specimens from Miller's Point are erect, about 100 mm long and only attached on the left posterior side. The tunic is translucent, hard, somewhat cartilaginous, up to 20 mm thick and covered with epibionts. The siphons are naked and protrude, the oral siphon to the anterior and the cloacal siphon towards the anterior quarter of the body. Both siphons have 6–8 lobes that are prolonged by a transparent tip. There is a red spot between each lobe. The colour in life is purple or red; it disappears in formalin. The small specimens from Saldanha Bay, 40 mm long, are deep red in life and the colour persists for some time in formalin, but fades.

Muscles are only present in the dorsal part of the body wall. These are symmetrically distributed on the sides of the body (Fig. 34A, B, D, E), an exceptional characteristic among the Ascidiidae. These probably provide an erect posture to these animals and stiffness to the tunic. In large specimens, there are about 60 oral tentacles on a crest, in 3–4 orders of size, with an underlying muscular ring. The prepharyngeal groove has two equal edges and is curved slightly dorsally. The neural ganglion is anterior near the protruding dorsal tubercle. The dorsal tubercle is C-shaped with an anterior opening and curled horns (Fig. 34G). The dorsal lamina is doubled above the neural ganglion and posteriorly forms a raised blade with small teeth on the rim. The transverse thickenings do not reach the edge of the blade and have no relationship to the teeth. The dorsal lamina encircles the oesophagus entrance; at this level and on the right side, the transverse vessels form a dented membrane (Fig. 340H).

The branchial tissue is undulated with 40 and 32 longitudinal vessels on the right and left sides respectively. The main papillae are large. The elongated branchial meshes may have up to 12 short stigmata. The branchial sac does not extend posteriorly under the digestive tract.

The gut of the largest specimens is totally enclosed in whitish tissue that consists of an accumulation of vesicles and testis lobes that largely conceal a

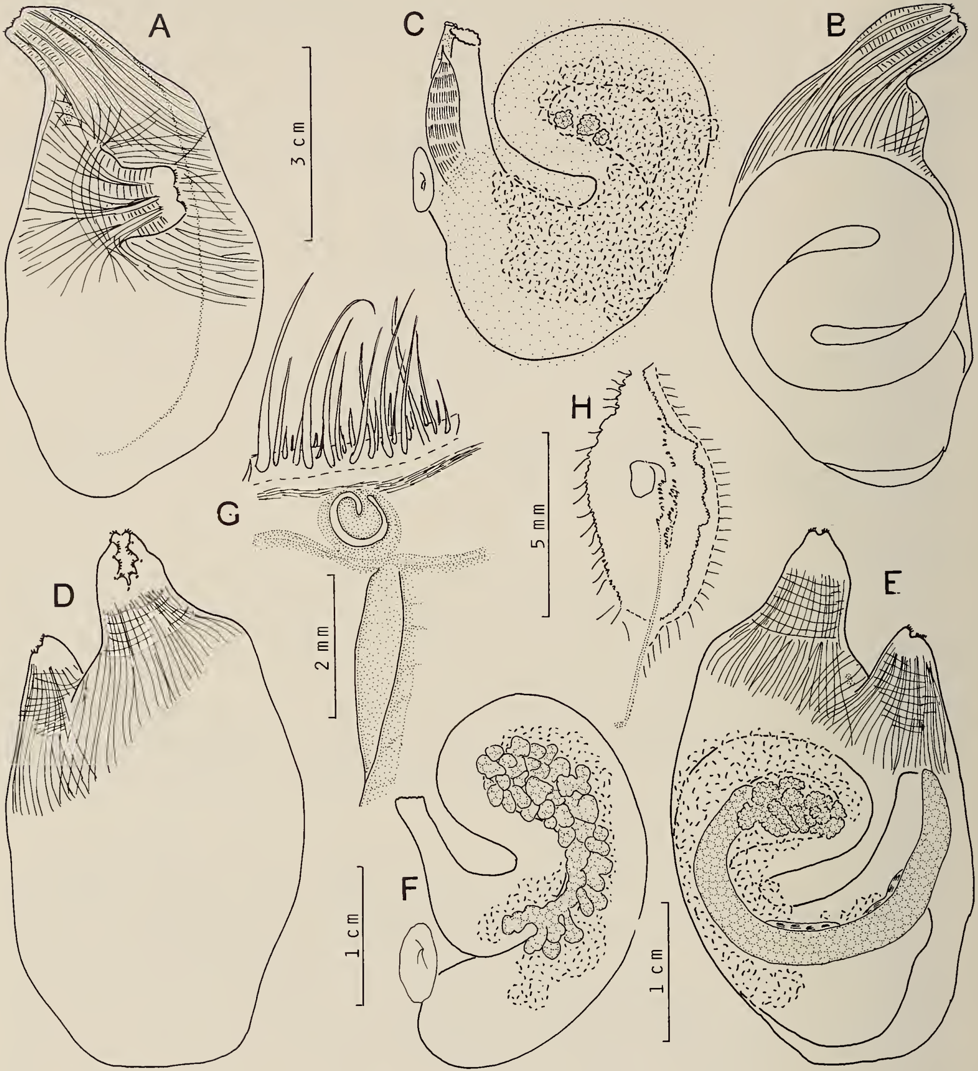

Fig. 34. *Ascidia incrassata.* A–B. Both sides of a large specimen. C. Gut and gonads of a large specimen. D–E. Both sides of a small specimen. F. Gut and gonads of a small specimen. G. Dorsal tubercle of a small specimen. H. Oesophagus entrance of a small specimen.

marked double gut loop (Fig. 34B, C). The stomach folds are not evident externally. The intestine, which is uniform in diameter, ends in small anal lobes. Although it is difficult to discern the shape of the different organs in large specimens, it is easier to observe the gut and gonads in small specimens from Saldanha Bay (Fig. 34E, F). They are mature and have numerous eggs in the cloacal cavity. They correspond to the descriptions of *Ascidia multitentaculata* by Hartmeyer (1912) and Millar (1964). They possess a large number of oral tentacles (more than 160) (Fig. 34G). The reduction in tentacle number during the growth to a larger size has been described several times, particularly by Millar (1960) for *Ascidia translucida* and *Cnemidocarpa verrucosa*. The branchial sac of small specimens has a similar number of longitudinal vessels as larger ones (36 on the right and 34 on the left), but the branchial meshes are square and enclose an average of seven stigmata. We found numerous duplications of the stigmata rows marked by intermediate papillae. The gut makes a double loop (Fig. 34E, F). The ovary is located in the primary loop and consists of numerous tight lobes that do not protrude beyond the gut loop. The testis covers most of the gut on both sides (Fig. 34E, F).

Remarks and distribution

Ascidia incrassata is only known with certainty from the Western Cape area, where it was last collected in 1931 (Michaelsen 1934). It possibly occurs in southern Mozambique (Michaelsen 1918). Michaelsen noted that *A. multitentaculata* differs from *A. incrassata* only in the number of oral tentacles, and proposed that it be considered a variety of the latter. *Ascidia multitentaculata* was only known from three specimens. Millar (1977: 204, fig. 24) described from Salvador Beach (Brazil) an additional specimen of similar size, which had very numerous tentacles and an S-shaped gut. The Brazilian specimen differs from the South African material, having muscles over the whole right side, more longitudinal vessels (80), no intermediate branchial papillae and an ovary in two parts, located within the two intestinal loops. Millar (1977) considered his identification doubtful, and this is also our opinion.

The specimen of *A. incrassata* from Inhaca described by Millar (1956) has the musculature and dorsal tubercle characteristic of *A. canaliculata*.

Ascidiella aspersa (Müller, 1776)

Ascidia aspersa Müller, 1776: 225.
For synonymy see Berrill, 1950: 154, fig. 47.

Material

Several specimens. Saldanha Bay Harbour; Cape Town; Hout Bay; Port Elizabeth (Monniot coll.).

Distribution

Ascidiella aspersa is an European species whose distribution extends from Norway (Trondheim Fjord) to the Mediterranean Sea and the Atlantic coast of Morocco. It has been recorded in Senegal as (*Ascidiella senegalensis* Michaelsen, 1915). Brewin (1946) noted its voluntary importation into the south of New Zealand. This species has now invaded harbours and lagoons in southern Australia. It has also been collected in Porto Nuovo Bay, Argentina (42°53'S 64°42'W).

Family **Styelidae**

Botryllus closionis **C. Monniot sp. nov.**

Figs 3G, 35

Sarcobotrylloides racemosum Hartmeyer, 1912: 274, pl. 37 (fig. 5), pl. 41 (fig. 9).
non *Botryllus racemosus* Quoy & Gaimard, 1834: 620, pl. 92 (figs 7–8).

Material

Holotype. SAM–A25856, Sea Point, Cape Town (33°55'S 18°23'E), low tide. Collected by C. L. Griffiths, 25 May 1994.

Other material. Several colonies, locality data as above (Griffiths and Monniot coll.).

Description

This species has a characteristic appearance in the photograph and in Michaelsen's colour plate (1912, pl. 37 (fig. 5)). The red zooids form circular systems in hollows of the upper tunic, giving the colony surface a partitioned pattern as suggested by the species name (closis = fence). It covers both sides of the fronds of the seaweed *Epymenia*. The tunic has a firm constistency.

The zooids (Fig. 35A, B) are 1.5–2 mm long and perpendicular to the colony surface. A large cloacal languet lies above a very wide cloacal opening which reveals a large part of the branchial sac (Fig. 35A, B). There are nine rows of stigmata. The branchial sac is asymmetrical: the two first rows are complete on the right side (Fig. 35B), but the second row does not reach the dorsal lamina on the left side (Fig. 35A). There are 12–15 stigmata in a half-row and 2–3 stigmata between the longitudinal vessels.

The oval stomach wall has about ten protruding folds that are slightly enlarged anteriorly.

The caecum is long, curved, and has a small dilation at the tip (Fig. 35A). The gut loop is short. The pyloric gland is not well developed. The anus opens at the level of the seventh stigmata row at the base of the exposed part of the branchial sac and has a smooth edge (Fig. 35A, B).

Each zooid is linked to the vascular network of the colony by several sinuses.

In the colony studied, the nourishing zooids only have rudimentary testes (Fig. 35A, B). The first-order buds have mulberry-shaped testes that are more developed than in the adult zooids. Several oocytes are present in the second-order buds.

Remarks

The description of *Botryllus racemosus* by Quoy & Gaimard (1834) from Australia is short and could apply to any *Botryllus* with circular systems. The drawings (pl. 92 (figs 7–8)) clearly show systems of zooids at the tunic surface, thus depicting material that does not belong to this species.

Sarcobotrylloides racemosum Hartmeyer, 1912, was synonymized with *Botryllus leachi* by Hartmeyer & Michaelsen (1928), with *B. magnicoecus* by

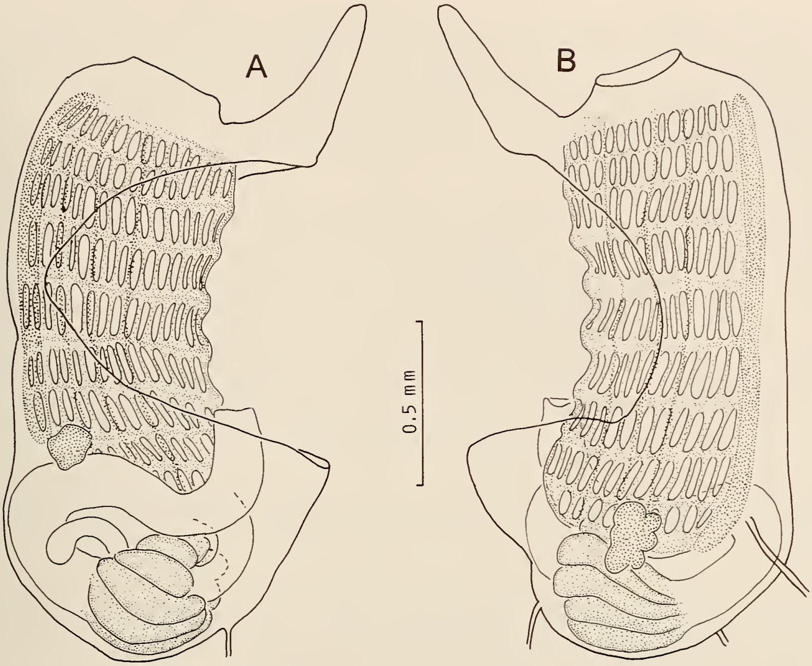

Fig. 35. *Botryllus closionis* sp. nov. A–B. Both sides of a zooid.

Tokioka (1967), and with *B. schlosseri* with some doubt by Kott (1985). *Botryllus schlosseri* sensu Kott, from Australia, is a different species from the European *B. schlosseri* and belongs to *B. aster* Monniot, C., 1991. None of the above synonymies are valid. The partitioned appearance of the colonies and its circular systems separate it from all other species of the genus.

Botryllus elegans (Quoy & Gaimard, 1834)

Figs 3H, 36

Distomus elegans Quoy & Gaimard, 1834: 623, pl. 42 (figs 11–13).
Synstyela monocarpa Sluiter, 1898*a*: 55, pl. 1 (figs 12), pl. 7 (figs 5–8).
Chorizocarpa elegans: Hartmeyer, 1912: 266. Michaelsen, 1915: 413, pl. 18 (fig. 37).
Botryllus anomalus Millar, 1962: 175, fig. 28. Monniot, C. & Monniot, F., 1976*a*: 359.

Material

Several colonies. Table Bay, Sea Point on *Epymenia* fronds (Griffiths and Monniot coll.).

Description

The colonies were thin encrustations on sea-weed fronds. The common tunic is transparent, often bluish with yellow circulatory ampullae of the tunic's blood system. The ampullae do not form a ring around the edge of the colony as is often the case in the genus. The zooids are spherical and regularly distributed.

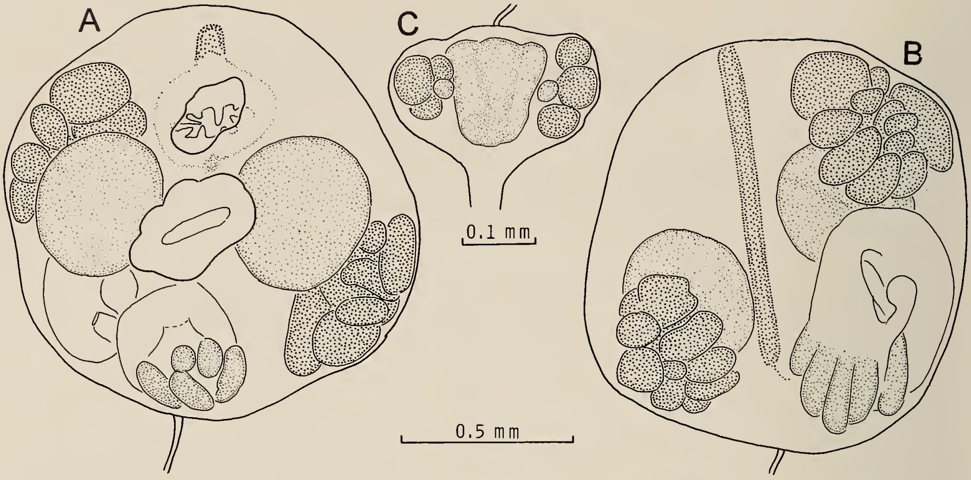

Fig. 36. *Botryllus elegans*. A. Dorsal side of a zooid. B. Ventral side of a zooid. C. Bud with gonads.

There are no systems; the cloacal siphons of the zooids open independently. The zooids are generally similarly orientated in the colony. There are white pigment spots that vary in number on the edge of the siphons.

The body wall is often yellow, except where it is red around the siphons and dorsally. All colour disappears after fixation.

We counted eight short oral tentacles. Three branchial longitudinal vessels on each side cross eight rows of oval stigmata. The gut (Fig. 36B) forms a closed loop. The globular stomach bears anterior grooves. The caecum has the shape of a pedunculate vesicle (Fig. 36B). The pyloric gland is small and does not encircle the intestine. The anus has a plain margin. The gonads are well developed. On each side there is a massive lobed testis ventrally (Fig. 36B) and a large egg dorsally (Fig. 36A). In some zooids the egg is segmented in four blastomeres.

We rarely observed even slightly developed buds in our material, but the few we found possessed *Botryllus* characteristics, i.e. gonads differentiated at the beginning of branchial development (Fig. 36C). No larvae were brooded in the zooids. Some were found in the common tunic enclosed in a membrane linked to the colony vascular system. Holes at the colony surface provided some evidence of degenerated zooids, and the larvae in their envelopes seemed to occupy the spaces vacated by zooids. Only one larva lies in each of these locations when the zooids produce two eggs. The larvae were not fully developed and had no vascular ampullae, only the beginning of a tail and one sensory organ.

Our specimens correspond well with the type material (MNHN BOT. B 14).

Remarks and distribution

We consider this a species of the genus *Botryllus*, as did Millar (1962), in view of its parietal budding with early development of the gonad, a characteristic only encountered in this genus.

In terms of its other characteristics, this species could belong to two other genera having three longitudinal branchial vessels on each side. In *Chorizocarpa* the testis is on the left side, the ovary on the right side, and the budding is vascular (Monniot, C. 1988). In *Botryllocarpa* the hermaphroditic gonads are placed on each side of the body, but the testis is deeply divided into two lobes as in the genus *Symplegma.*

Botryllus elegans has unique features for the genus: the absence of systems, and larvae brooded in the common tunic rather than the zooids. The mode of development of the larvae also seems different from that described by Zaniolo *et al.* (1998) for *Botryllus violaceus*. The life cycle of this species thus merits further studies.

The description of *Distomus elegans* Quoy & Gaimard, 1834, is extremely short and only provides its external characteristics, but the coloured illustrations leave no doubt about the species' identification. The siphons are depicted as having six lobes, which is not the case in our specimens and this is probably an error in the illustrations.

Sluiter (1898*a*) did not recognize *Distomus elegans* and created a new species, *Synstyela monocarpa.* Hartmeyer (1912) ignored Sluiter's species and created yet another species, *Chorizocarpa elegans*.

Michaelsen (1924), on re-examining Sluiter's samples, noticed labelling errors between specimens from South Africa and colonies collected in the north of Australia that Sluiter (1900) had described under the name *Synstyela michaelseni*.

Moreover, other specimens labelled from South Africa were labelled as *Symplegma* species. Michaelsen concluded that there were two species in South Africa: one with four longitudinal vessels that he identified as *Symplegma*

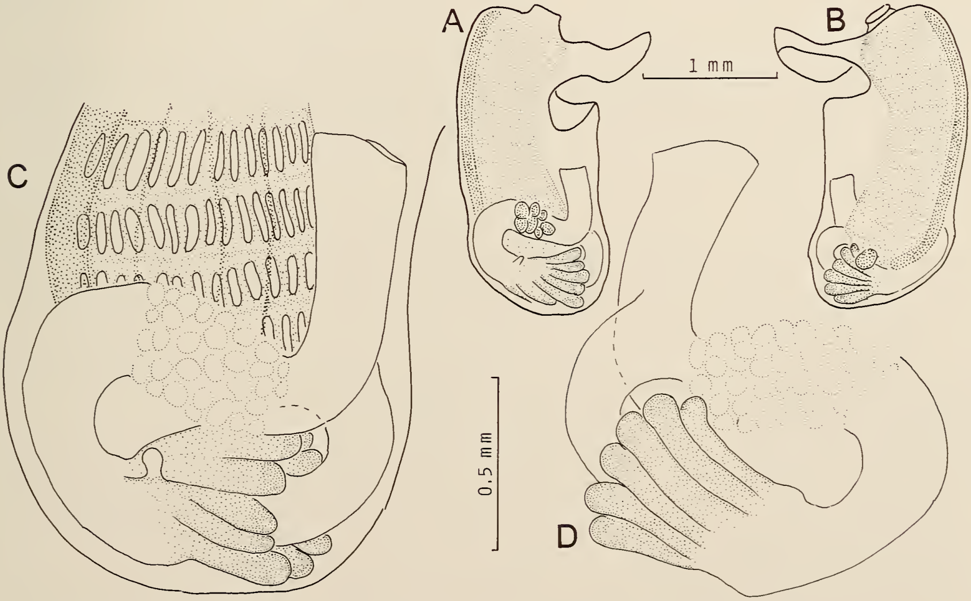

Fig. 37. *Botryllus gregalis*. A–B. Both sides of a zooid. C–D. Details of the gut.

elegans (Quoy & Gaimard, 1834), and another with three longitudinal vessels identified as *Chorizocarpa monocarpa* (Sluiter, 1898*a*). This last species might have been confused with *Chorizocarpa michaelseni* (Sluiter, 1900) from northern Australia, in view of Sluiter's labelling errors, and Michaelsen was surprised by the synonymy considering the distance between the populations. He suggested that further collections were necessary. He overlooked the fact that, in 1915, he combined as synonyms *Distomus elegans* and *Synstyela monocarpa.* He thus considered *Distomus elegans* to be the commonest species of the genus *Symplegma*, partly because six oral lobes were figured by Quoy & Gaimard, and because specimens of *Symplegma* were mixed with Sluiter's specimens.

We similarly found errors in the synonymies of *Symplegma brakenhielmi* and *Chorizocarpa michaelseni.* The synonymies listed above only correspond to descriptions of specimens and does not take into account more or less erroneous citations.

Botryllus elegans is known from Namibia to southern Mozambique.

Botryllus gregalis (Sluiter, 1898*a*)

Figs 4A, 37

Botrylloides gregalis Sluiter, 1898*a*: 46, pl. 2 (figs 6–9).
Botrylloides nigrum non Herdman, 1886. Hartmeyer, 1912: 270, pl. 41 (fig.10).
Part *Botrylloides leachi* non Savigny, 1816. Hartmeyer & Michaelsen, 1928: 342.
?*Botrylloides leachi*: Michaelsen, 1934: 154.
?*Botrylloides leachi*: Millar, 1962: 177.
Botryllus gregalis: Monniot, C. & Monniot, F., 1997: 1633, text-figs 5–6, pl. 1C, D.

Material

Several specimens. Saldanha Bay, on kelp; False Bay, 8–12 m; Cape Town, 10 m; Isipingo, KwaZulu-Natal (Griffiths coll.); Knysna and Port Elizabeth (Monniot coll.); Sodwana Bay, KwaZulu-Natal (Schleyer coll.).

Description

The colonies are 2–3 mm thick in this species. The colour varies and the oral siphons and cloacal languets are generally opaque. The zooids are distributed along an anastomosed network of cloacal cavities that have few common cloacal openings.

The zooids have 12–13 rows of stigmata, the second row being dorsally incomplete on both sides (Fig. 37A, B). The cloacal aperture extends one-third of the branchial height, under a large cloacal languet. The anterior end of the stomach (Fig. 37C, D) is wide and has about ten folds, which flare anteriorly and attenuate posteriorly. The caecum is always small but sometimes enlarged at the tip (Fig. 37C). A well-developed pyloric gland of joined vesicles surrounds the intestine like a sleeve (Fig. 37C, D). The rectum is wide and opens at the eighth or ninth row of stigmata without narrowing.

None of the colonies studied had eggs or embryos. The nourishing zooids have degenerated testes located posteriorly against the gut (Fig. 37A, B). The first-order buds have well-developed testes. The ovaries have few oocytes and develop on the second-order buds.

Remarks and distribution

It is possible that the specimen named *Botrylloides leachi* by Michaelsen (1934) belongs to this species, together with the specimens that Millar (1962) considered doubtful. The specimen described by Hartmeyer (1912) as *Botrylloides nigrum* from the Cape Peninsula has exactly the same stomach as the specimens in our collection, and Michaelsen (1934) expressed doubt as to its identification.

This polymorphic species has a continuous distribution along the west coast of South Africa, and extending to the Arabian Gulf.

Botryllus maeandrius (Sluiter, 1898*a*)

Figs 4B, 38

Botrylloides maeandrium Sluiter, 1898*a*: 48, pl. 2 (fig. 7), *non* pl. 6 (fig. 10).
?*Botrylloides translucidum* Hartmeyer, 1912: 272, pl. 37 (fig. 3), pl. 41 (figs 8–12).

Material

Several colonies; one of them adult, on a *Mytilus* shell, represents a neotype, SAM–A25862. Sea Point, intertidal (Griffiths and Monniot coll.).

Description

The colonies are thin and encrusting. The zooids are distributed in double rows on each side of large, branched cloacal channels. Some zooids are found in circular systems, but are facing by their ventral part. There are only a few common cloacal apertures that do not protrude and are hardly visible. The colonies often have a branched pattern with rows of zooids radiating in all directions from the colony centre. The edge of the colony is marked with an accumulation of vascular ampullae. The colour is a uniform pink to reddish-pink. The pigment cells are more dense around the oral siphons and in the vascular ampullae. The tunic matrix is colourless. After fixation the pigment fades and the zooids become brownish.

The zooids have a wide rectangular cloacal languet above a large cloacal opening that reveals a large part of the branchial sac (Fig. 38A, D). There are 9–10 rows of a dozen stigmata per side and the second row does not reach the dorsal line (Fig. 38E).

The conical stomach (Fig. 38B) is asymmetrical and dilated with a dozen anterior folds that are mere protrusions on the left side but become progressively longer and form folds on the right side (Fig. 38D). The caecum is a small pedunculate ball (Fig. 38B). The intestine is constricted by a voluminous pyloric gland that encircles it. The gut loop is well defined. The anus opens in front of the fifth or sixth row of stigmata and has a curled rim.

Most colonies have no gonads at all. The colonies collected in February were male or hermaphroditic. In male colonies the testes appear on first-order buds. In hermaphroditic colonies (Fig. 38A) the zooids have bulky testes with

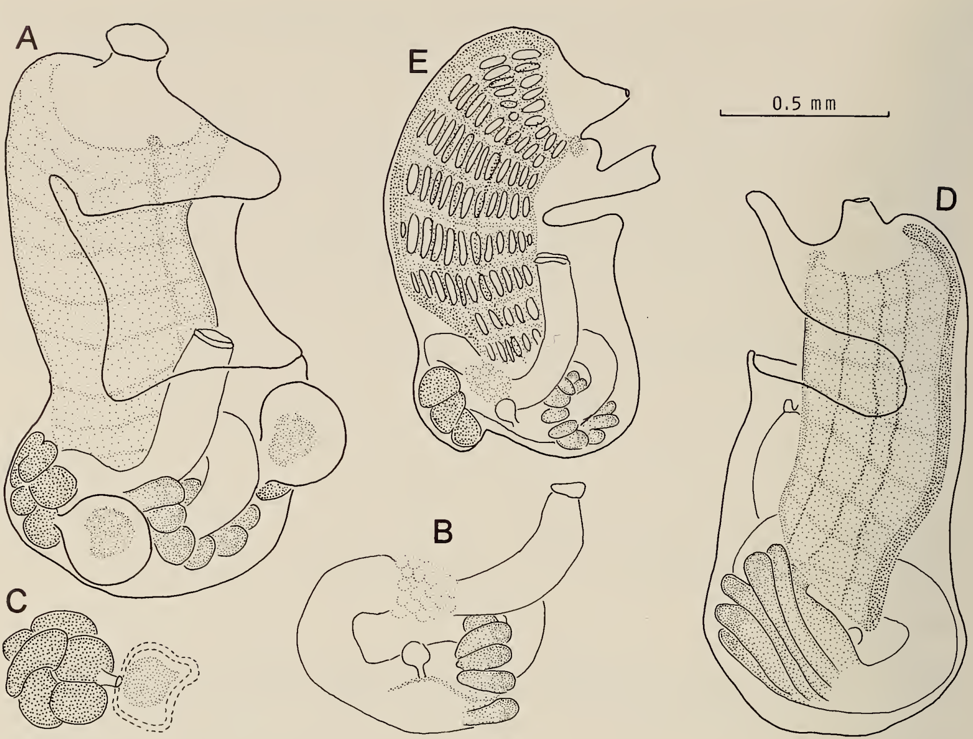

Fig. 38. *Botryllus maeandrius*. A. Zooid. B. Gut. C. Hermaphroditic gonad. D–E. Two additional zooids.

less than ten lobes. These protrude slightly to the exterior and are located almost at the same level in the posterior and ventral part of the body. An ovary located dorsal to the testis in a pedunculate pouch (Fig. 38A) contains one or two degenerated eggs.

Remarks

We have re-examined the type of *B. maeandrium* Sluiter, 1898*a* (ZMA TU 297). It is not well enough preserved to be redescribed, but does not correspond either to Sluiter's description or pl. 6 (fig. 10) of the species. It has no systems and may either be *Botryllus elegans* or a species of *Symplegma.* However, Sluiter's (1898*a*, pl. 2 (fig. 7)) colour drawing corresponds well to the species described here. His pl. 6 (fig. 10) is surprising; it depicts a zooid with five longitudinal vessels, a small cloacal aperture, a gut with the structure of a *Botryllus*, and gonads with a non-protruding ovary in the position in which it is found in *B. elegans*. His zooid description corresponds to this figure. The labelling of Sluiter's specimens is often erroneous, as Michaelsen (1924) has already noted, and it is not rare to find several species from different families in one of his type samples. His descriptions sometimes appear to be fanciful if not totally imaginary.

We propose to use the name *Botryllus maeandrius* (Sluiter, 1898*a*) for this species to simplify the synonymy, as the original description has no value and the type specimen has been lost. We have made an adult colony collected at Sluiter's type locality, Sea Point (Cape Peninsula), a neotype for the species.

The description of *Botrylloides translucidum* Hartmeyer, 1912, corresponds to this species in some respects, as it describes an ascidian with the same gut shape, and an elongated stomach with short posterior protruding rods. However, Hartmeyer's colonies are 9-mm-thick cushions, with zooids with 12 rows of stigmata and no pyloric caecum. These attributes are characteristic of *Botryllus translucidus*, leading us to conclude that it is closely allied to if not identical with *B. gregalis*.

Botryllus maeandrius has been recorded only from the Cape Peninsula, South Africa.

Botryllus magnicoecus (Hartmeyer, 1912)

Figs 4C, 39

Botrylloides nigrum magnicoecum Hartmeyer, 1912: 271, pl. 41 (fig. 11); 1913: 135.
Botryllus magnicoecus: Michaelsen, 1921: 6, pl. 1 (figs 1–4); 1934: 154. Millar, 1955: 195, fig. 22; 1962: 175.

Material

Several colonies. Table Bay, 9 m; False Bay, 0–10 m (Griffiths coll.); Saldanha Bay, Hout Bay Harbour, and Kommetjie intertidal (Monniot coll.).

Description

The flat fleshy crusts of this species may be lobed or hang in double-sided sheets in harbours. In Hout Bay Harbour, the suspended colonies reach several decimetres. The oral apertures in almost all colonies are circled with white pigment, which contrasts with their pink colour. One colony from Miller's Point had reddish zooids in a yellow tunic. The zooids are arranged along a network of cloacal channels. There are only a few common cloacal apertures; they do not protrude at the colony surface.

The zooids have a cloacal languet of variable size, sometimes very short. The transverse cloacal opening may reveal half the length of the branchial sac. There are 12–15 rows of stigmata of which the second does not reach the dorsal lamina on either side of the body (Fig. 39A). The short oval stomach (Fig. 39B) bears 8–10 rods without anterior swellings and is well defined at the pyloric extremity. The caecum is long, cylindrical and often curved in a hook (Fig. 39B). The pyloric gland is small. The anus when contracted appears bilobed.

None of our specimens had ovaries or larvae. The nourishing zooids only had a multi-lobed testis on each side, the right one adjacent to the stomach (Fig. 39A, C) and the left one more anterior at the level of the intestine. The first-order buds (Fig. 39C) have testes as large as those of the nourishing zooids. Ovaries with 1–3 oocytes only appear in buds of the second order.

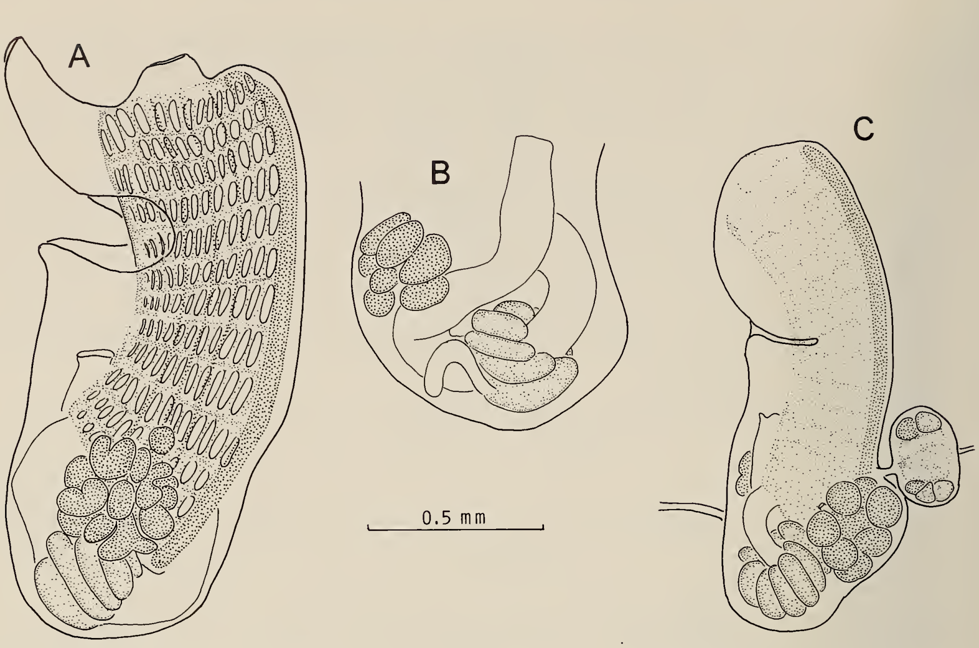

Fig. 39. *Botryllus magnicoecus*. A. Zooid. B. Gut. C. Buds of first and second orders.

Remarks and distribution

When fixed, the pigments fade and *B. magnicoecus* becomes similar in appearance to *B. gregalis*. The number of stigmata rows and the body shape are similar. The species only differ in the shape of their stomach and the caecum. This is probably why Hartmeyer (1912) considered this a variety of his *Botrylloides nigrum,* which, in our opinion, is *Botryllus gregalis* (see p. 74).

The name *B. magnicoecus* has been used worldwide for all species having a large caecum. Michaelsen (1923*b*) recorded this species in Portugal, the Red Sea, and Hong Kong. Hartmeyer & Michaelsen (1928) increased the confusion when they included the Australian *B. anceps* as a synonym.

The geographic distribution of *B. magnicoecus* in South Africa seems to be limited to the coast from Namibia to KwaZulu-Natal. All specimens recorded from other parts of the world, viz. the Mediterranean Sea, Portugal, Caraibes, Australia and Japan, belong to other species.

Botryllus mortenseni Millar, 1964

Figs 4D, 40

Botryllus mortenseni Millar, 1964: 176, fig. 13.

Material

One large colony and several small ones attached to other ascidians. Isipingo, KwaZulu-Natal, rock pools (Griffiths coll.).

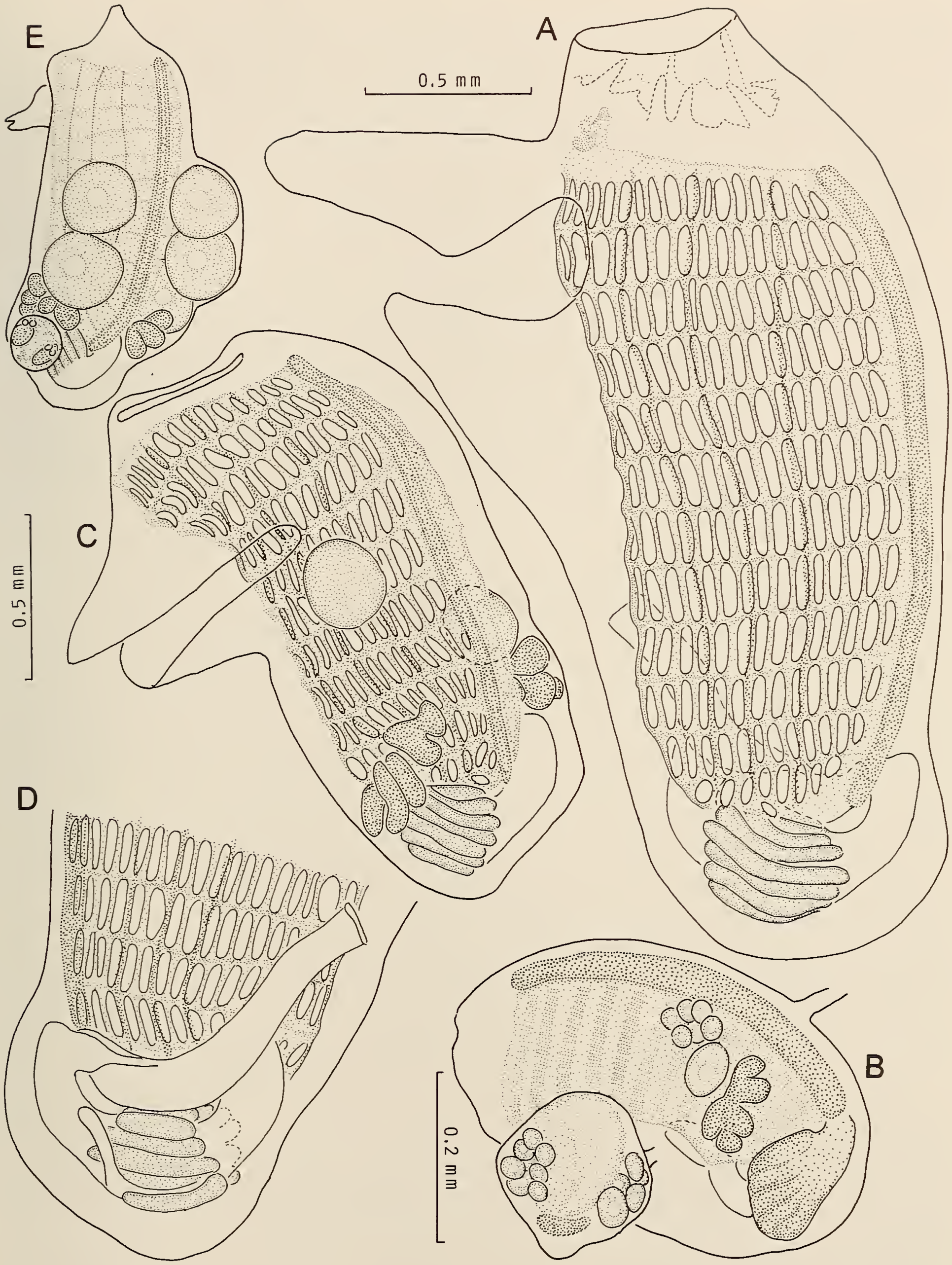

Fig. 40. *Botryllus mortenseni*. A. Nourishing zooid of the largest colony. B. Buds of first and second orders of the same colony. C. Nourishing and brooding zooid of a small colony. D. Gut of zooid C. E. Zooid with oral siphon not yet open but with mature gonads, in another colony.

Description

The largest colony is a cushion 5–6 mm thick, embedded with sand. Its black colour fades in formalin. The zooids are perpendicular to the colony surface and organized in circular systems around numerous common cloacal openings. The zooids are large, 3 mm in length, with a slit-shaped cloacal aperture and a long anterior conical languet and a posterior lip almost as long as the languet (Fig. 36A, C). The branchial sac has 12 rows of stigmata, all reaching the dorsal line (Fig. 36A). On the right side, some perforations represent a thirteenth row. The stigmata are numerous and there is an average of three between each internal longitudinal vessel. The stomach is oval, with a dozen folds that protrude slightly at the anterior end but flatten out at the posterior. The caecum is long, narrow and cylindrical (Fig. 36D). The secondary loop of the intestine is not accentuated and the rectum extends along 4–5 rows of stigmata, opening at the level of the eighth row. In the large colony, the nourishing zooids sometimes have a rudimentary testis. Ovaries with numerous oocytes appear in second-order buds and are also present in first-order buds (Fig. 36B).

Small colonies consisting of a single system were found on other ascidians at the same station. The smaller zooids (Fig. 36C), less than 2 mm long, have a cloacal aperture shaped like a whistle. There are only 11 complete rows of stigmata and a beginning of a twelfth row on the right (Fig. 36C). The nourishing zooids are hermaphroditic with a testis made of elongated fan-shaped lobes and 1–2 eggs anterior to the testes on each side (Fig. 36C). We observed a trace of segmentation in these eggs, which do not protrude outside the body wall. There are 2–3 eggs on each side in first-order buds (Fig. 36E).

Remarks and distribution

The type specimen of this species was collected 22 miles south-west of Cape Point at 55 m depth, and it is a little different to the specimens from Isipingo. The colony is thicker (15 mm) and the zooids are longer (4–5 mm). The scale included in Millar (1964, fig. 13) is probably erroneous and may correspond to 1 mm. The oral siphon is tubular. There are 16–18 rows of stigmata. Both of Millar's other specimens were dredged from Mossel Bay at 16 m depth, and have shorter and wider cloacal siphons than in our specimens.

We consider that the colonies collected at low tide at Isipingo belong to this species in spite of these differences. *Botryllus* species are relatively variable according to colony thickness. In Europe, we have observed that the zooids of *B. leachi* and *B. schlosseri* are larger and have more rows of stigmata in spherical colonies than in encrusting colonies. This was the reason that the now abandoned genera *Polycyclus* and *Sarcobotrylloides* were created for thick colonies. The length of the cloacal siphons is related to the distance between the zooid and the common cloacal aperture, and thus the age of the system and the position of the bud.

The small colonies at Isipingo were sexually mature whereas the larger ones were not. This phenomenon may be linked to ecological difficulties encountered by the small colonies, which react by maturing gonads.

Three other species of *Botryllus* impregnated with sand are known from elsewhere. They are closely allied and have in common a thick tunic, circular systems, zooids perpendicular to the colony surface, a whistle-shaped cloacal siphon placed anteriorly and sometimes in a tube, a branchial sac with an entire second stigmata row, and an ovary anterior to the testis with several eggs.

Botryllus stewartensis Brewin, 1958, from the south of New Zealand and Australia (Kott 1985) has small pedunculate lobes, distantly spaced, consisting of 1–3 systems. The stomach is oval with a long caecum. The testis is fan-shaped.

Botryllus arenaceus Monniot, C., 1988, from New Caledonia has lobes with a single system, a wide stomach with protruding folds at its anterior part, a caecum with an ampullae at the tip, and a mulberry-shaped testis.

Botryllus okai Monniot, C., 1988 (new name for the preoccupied *Psammobotrus purpureus* Oka, 1932), from Japan, has massive colonies with numerous systems. The stomach is similar to that of *B. mortenseni*, but has an ampullar caecum and an anus with a curled margin. The gonads have not been described and were only present in buds in specimens that we examined. The testis has elongated lobes.

Botryllus schlosseri (Palas, 1766)

Alcyonium schlosseri Pallas, 1766: 355.

Remarks

We have only collected this species in harbours, in Saldanha Bay and Hout Bay. The colonies are small, thin and encrusting. The zooids form circular systems. Live specimens are a green-brown colour. None of these colonies had gonads. This species has been previously recorded in South Africa, from Durban Harbour (Millar 1955).

Symplegma ?bahraini Monniot, C. & Monniot, F., 1997

Fig. 4E

Symplegma bahraini Monniot, C. & Monniot, F., 1997: 1638, text-fig. 7, pl. 1E, F.
?*Symplegma viride*: Millar, 1955: 196, fig. 24.

Material

Three colonies. Sodwana Bay, KwaZulu-Natal, 30–33 m (Schleyer coll.); Isipingo, KwaZulu-Natal, rock pool under overhang (Griffiths coll.).

Description

None of our three colonies has gonads, so the identification could not be made with certainty. An important characteristic of the species is the simultaneous presence of functional male and female gonads.

The uniform red colour of the colony from Isipingo was the same as in the type colony (Monniot, C. & Monniot, F. 1997, pl. 1E). The colonies from Sodwana Bay were pink-brown, with yellow individuals. Another colony from

Bahrain also was yellow in colour. Yellow samples were also collected in the Mozambique Channel, at Juan de Nova Island and in the north of Mozambique.

The samples from South Africa have a short gut and a branchial sac with 11 stigmata rows, as in the Bahrain specimens.

Remarks and distribution

Millar (1955) recorded the presence of *S. viride* in the Durban Harbour entrance but did not describe it. Millar referred to Van Name's (1945) description, which in reality represents *S. brakenhielmi* (Michaelsen, 1904*b*). The latter has been found in many harbours in the Atlantic Ocean, Australia, and the Pacific Ocean (often under the name *S. oceania*). *Symplegma brakenhielmi* does possibly occur in Durban Harbour. That species differs from *S. bahraini* in that its pigmentation is limited to the branchial vessels. When fixed all colour disappears, which is what Millar saw.

***Metandrocarpa asymmetra* C. Monniot sp. nov.**

Fig. 41

Material

Holotype. SAM–A25857, Oudekraal, Cape Peninsula (33°59'S 18°21'E), 10 m depth on *Styela angularis*. Collected by C. L. Griffiths, 18 Aug. 1994. Unique.

Description

The colony consists of zooids at different developmental stages, all having female gonads. The zooids form small pink spheres, 4 mm in diameter, linked by very thin stolons, with closely spaced siphons. The tunic is thin. The translucent body wall contains weak musculature.

Twenty to 24 short thick oral tentacles in 3–4 orders of size are mounted on a crest (Fig. 41A, B). The prepharyngeal band has only one protruding edge which is not dorsally indented (Fig. 41A, B). The dorsal tubercle protrudes and has an elongated opening next to the neural ganglion. The dorsal lamina has a smooth edge that is displaced on the left side and turns around the oesophagus entrance.

The branchial sac is asymmetrical, hence the species name. It has seven longitudinal vessels on the right but only four on the left side. The 11 stigmata rows are each crossed by a thin parastigmatic vessel, except for the most posterior row. The stigmata are regularly spaced. Their number is indicated in the formula:

R.E. 8 v 4 v 5 v 4 v 4 v 4 v 4 v 4 to 15 D.L. 5 v 8 v 7 v 9 v 12 E.L.

In the anterior part of the branchial sac, the number of stigmata is the same on both sides. The first vessel deviates from the dorsal lamina and we found up to 15 stigmata at the level of the oesophagus.

The oesophagus is long and cylindrical, the stomach is wider than it is long (Fig. 41A, B) with 14 folds that are sometimes interrupted. The caecum forms a thin hook (Fig. 41C). The pyloric gland opens through a duct just before the

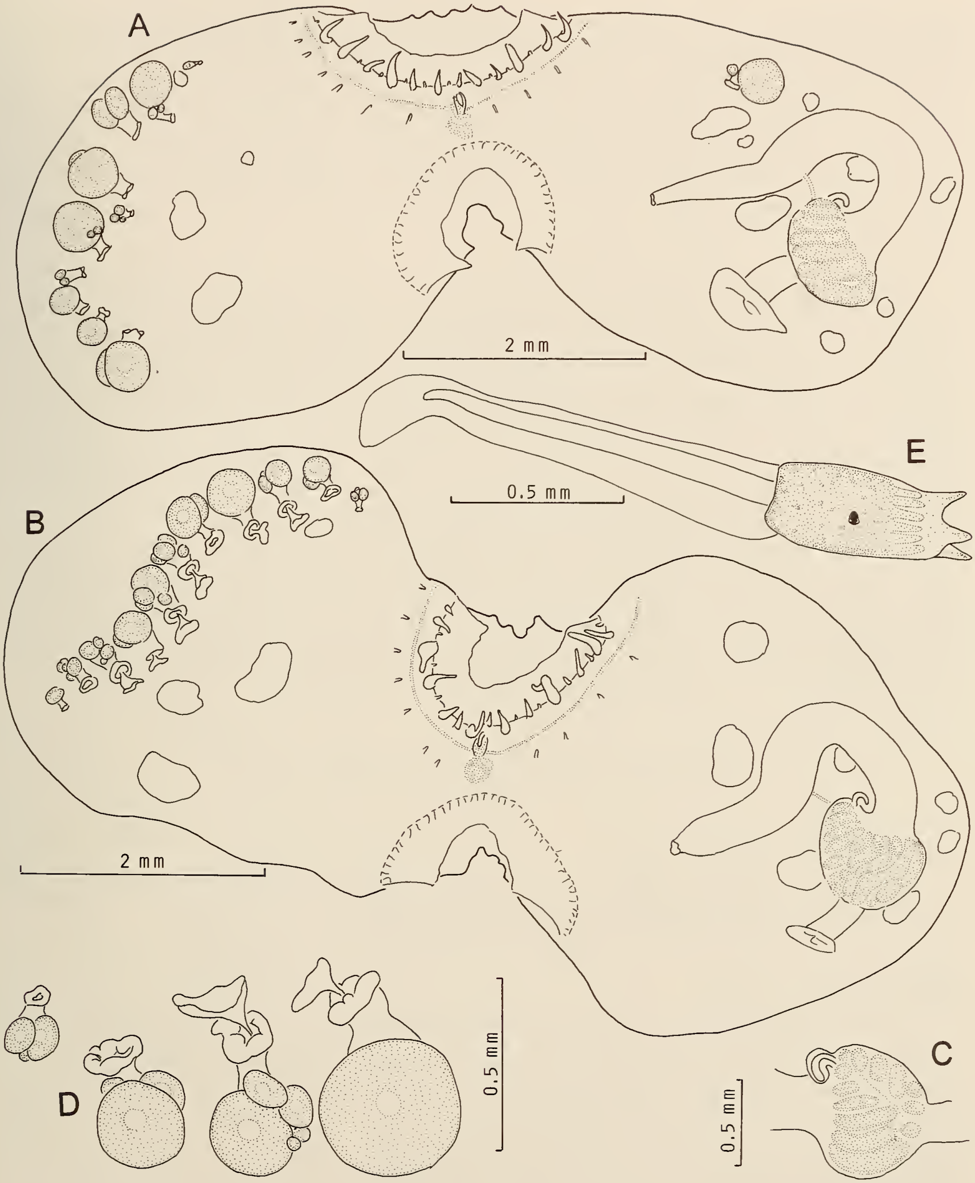

Fig. 41. *Metandrocarpa asymmetra.* A. Young zooid with ovaries on both body sides. B. Aged zooid with gonads on one side only. C. Stomach. D. Detail of the gonads. E. Larva.

caecum (Fig. 41A, B). The intestine ends in a slightly narrowed rectum. When contracted the anus is square, but it lacks angles when relaxed.

Ten to eleven ovaries lie in a line on the right side of the body (Fig. 41B), and one, two or three ovaries are found on the left side of the body, anterior to the gut loop (Fig. 41A). Each ovary is made of a few oocytes and a large papilla (Fig. 41D). The papilla is narrow at first but becomes thick with a fleshy rim when the eggs are laid (Fig. 41D). The larvae (Fig. 41E) are brooded in a cup formed from the external egg follicle; this structure remains behind when the larvae are released. There are some endocarps on the body wall. A ring of small tentacles encircles the base of the cloacal siphon (Fig. 41A, B). Both siphons possess a velum.

Remarks

The genus *Metandrocarpa* is characterized by separate male and female gonads and the absence of branchial folds. Kott (1985) modified the diagnosis to include *M. agitata* Kott, 1985, which possesses true branchial folds. We do not agree with this modification, as it suppresses the difference between the genera *Amphicarpa* and *Metandrocarpa*. *Metandrocarpa agitata* is in fact an *Amphicarpa*. Generally the *Metandrocarpa* species have male and female gonads in the same colony. *Metandrocarpa sterreri* Monniot, C., 1972, from Bermuda and the Caribbean islands, also has dioecious colonies.

Metandrocarpa asymmetra is also original in the asymmetry of the branchial sac. Millar (1962) described *M. fascicularis* from Mossel Bay. That resembles *M. asymmetra* superficially, but the species are distinct. *Metandrocarpa fascicularis* has 7–9 longitudinal vessels on each side depending on its age, an elongated stomach, anterior ovaries and posterior testes.

***Distomus antiborealis* C. Monniot sp. nov.**

Fig. 42

Material

Holotype. SAM–A25858, Saldanha Bay (33°03’S 18°02’E), 1–2 m depth. Collected by C. and F. Monniot, Feb. 1996. Unique.

Description

The zooids are in the shape of small spheres, 10 mm in diameter and covered with sand. The siphons are close together. The tunic is tough. The body wall is thin but opaque with a regularly distributed musculature. Sixteen wide and thick oral tentacles form a crown at the base of the siphon. Some smaller tentacles are irregularly intercalated between them. The prepharyngeal band has only one high rim and it forms a short dorsal indentation. The dorsal tubercle is protruding and opens through an antero-posterior slit. The dorsal lamina is high, with a smooth edge; it ends mid-length along the oesophagus entrance. The endostyle is not fully attached to the body wall but only connected to it by thin trabeculae.

The reduced branchial sac has one fold on the right and two on the left side. The first fold on the left side is reduced and limited to the anterior part of the branchial sac. We counted ten vessels anteriorly on each side, arranged according to the formula:

R. E. 5 (4) 1 D. L. (3) 2 (3) 2 E. L.

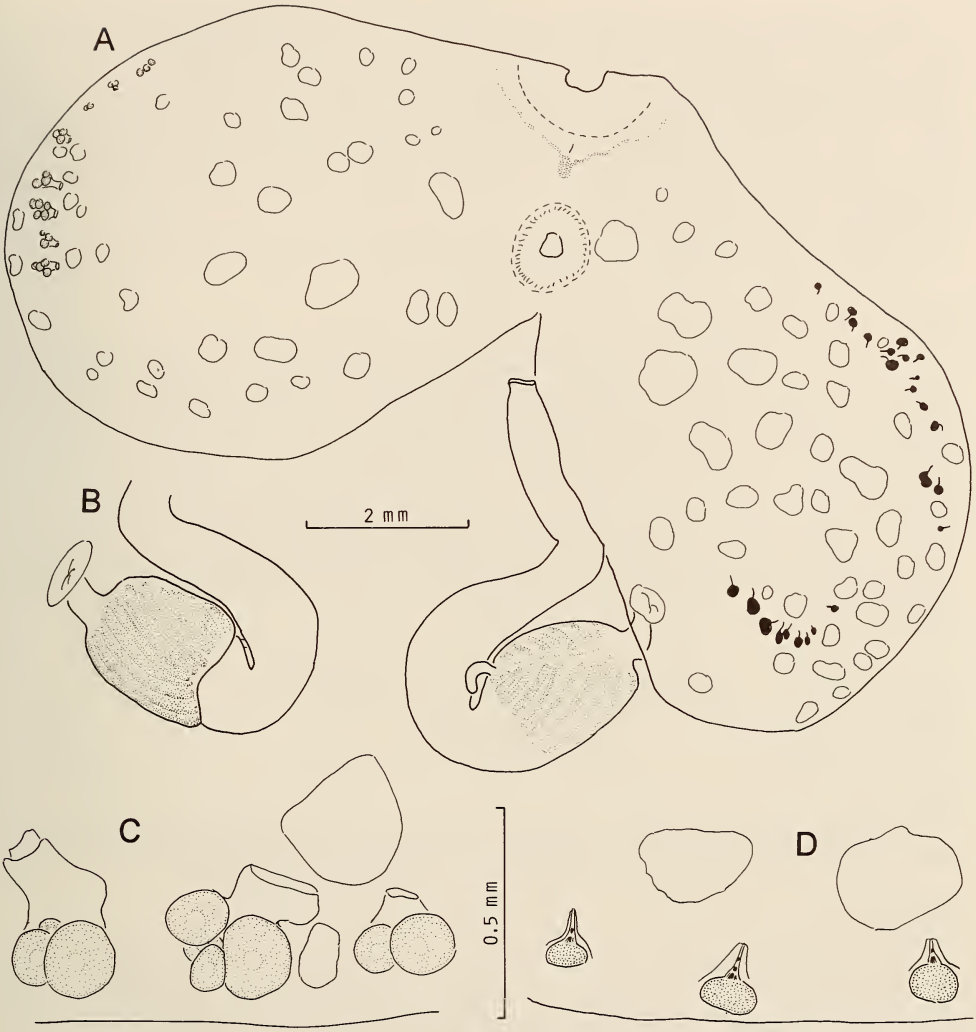

Fig. 42. *Distomus antiborealis* sp. nov. A. Zooid with reversed gut. B. Gut. C. Young ovaries. D. Young testes.

The most dorsal vessel on the right fold and the three vessels of the first left fold disappear in the median part of the branchial sac. There is a large space between the dorsal lamina and the first vessel, containing up to 16 stigmata on the right side. There are 7–9 stigmata in a mesh between the folds and two on the folds. The 14 rows of long stigmata are crossed by parastigmatic vessels only in the ventral part.

The oval stomach has a hook-like caecum and about 20 oblique grooves, most of them ending at the ventral axis of the stomach (Fig. 42A, B). The intestine is short. The rectum ends in a smooth-edged anus far from the cloacal aperture.

The zooids are not mature, but the gonads are developed enough to characterize the genus. Eight ovaries with several oocytes (Fig. 42C) lie in a line on the right side (Fig. 42A) alongside the trabeculae between the endostyle and the body wall. The oviducts are directed toward the dorsal side. The testes (Fig. 42D) are functional, in small flask-shaped ampullae. They are irregularly distributed on the left side along a line curving posteriorly (Fig. 42A). Some testes are located under the gut.

Numerous endocarps of varied sizes are present on the body wall. The cloacal tentacles are short, thin and numerous.

Remarks and distribution

Distomus antiborealis is the first species of *Distomus* recorded in southern Africa. The genus is more frequently encountered along the Atlantic coast from Senegal to the North Sea and in the Mediterranean Sea. One species inhabits deep submarine mounts in the south of New Caledonia.

The genus *Distomus* is related to the genera *Amphicarpa* and *Stolonica*. It is only characterized by female gonads on the right side of the body and male gonads on the left side of the body. In other species of the genus the testes are less numerous and larger. Their presentation here is reminiscent of the genus *Amphicarpa*.

***Stolonica multitestis* C. Monniot sp. nov.**

Figs 4F, 43

Material

Holotype. SAM–A25859, Isipingo, KwaZulu-Natal (30°00'S 30°57'E), in rock pools. Collected by C. L. Griffiths, 10 July 1994. Unique.

Description

The zooids are joined only in the basal region by stolons and form sheets 10 mm thick. The oral siphon is terminal, the smaller cloacal siphon more lateral. The thin tunic includes some sediment. In life the tunic is orange-red with, between the siphons, two symmetrical white patches separated by an unpigmented area corresponding to the neural ganglion.

The body wall is transparent with a thin musculature. We counted about 30 stout oral tentacles joined at their wide bases, in several orders, but not very different in length. There are some others between them, variable in size but much smaller. The tentacles lie on a muscular ring. The prepharyngeal band has two high closely spaced membranes drawing a small dorsal curve. The dorsal tubercle protrudes slightly and is transversely elongated near the neural ganglion. The dorsal lamina is long, thin, low, and encircles the oesophagus entrance. The branchial sac has three folds on the right side and two folds on the left side. In the anterior part we counted:

R.E. 3(4) 2(5) 3(5) 3 D.L. 0(6) 3(6) 8 E.L.

The only folds to reach the oesophagus entrance are the first fold on the right and the second fold on the left. The most dorsal vessels disappear in the

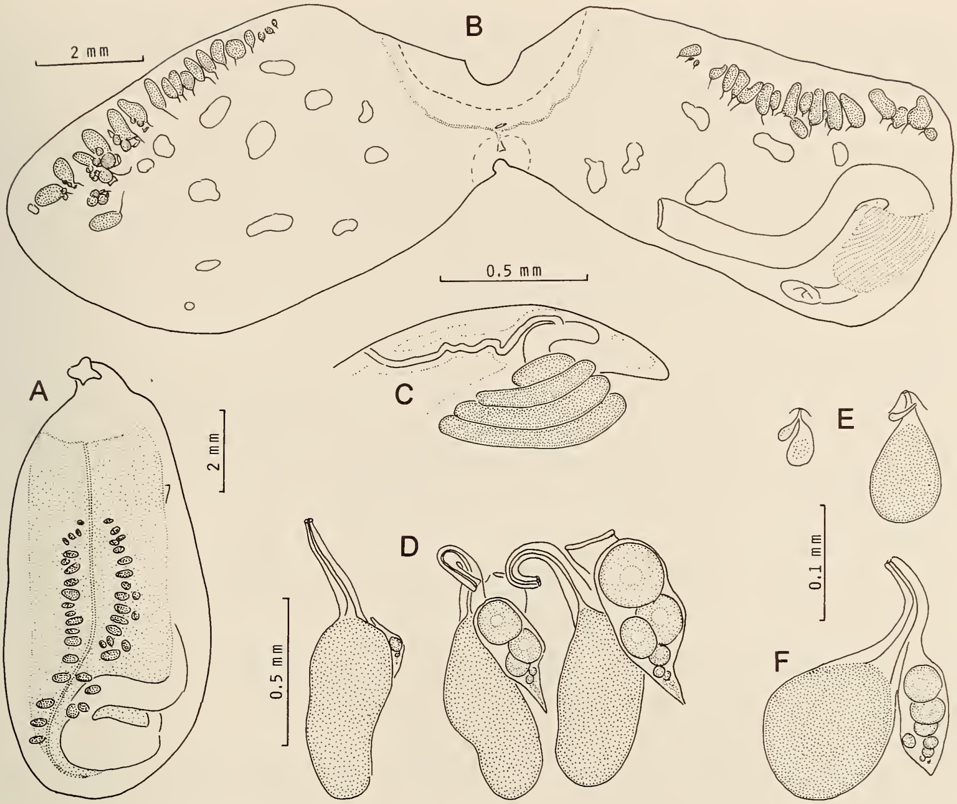

Fig. 43. *Stolonica multitestis* sp. nov. A. Ventral side of a zooid. B. Internal side of a zooid. C. Gastric caecum and pyloric duct. D. Right gonads. E. First stage of left gonads. F. Right gonad at the same stage as E, same scale.

posterior part of the branchial sac. On the left side, the first fold is parallel to the dorsal lamina.

On the right side, the first three longitudinal vessels are parallel to the dorsal lamina and three additional vessels appear successively between vessel number 3 and the base of the first fold. There are thus six vessels between the dorsal lamina and the first fold in the posterior part of the branchial sac. In some zooids there is a rudiment of a third fold on the anterior left side due to two incomplete vessels arising dorsal to the third vessel from the endostyle.

Of the 16 rows of stigmata, the most anterior 14 are regularly cut by a parastigmatic vessel, the fifteenth is incompletely divided, and the last one is irregular. There are 6–7 long stigmata within a mesh and three under the folds.

The stomach (Fig. 43B, C) widens at the pyloric end. There are about 35 regular parallel grooves and a small finger-like caecum. The duct of the pyloric gland is conspicuous and enters the caecum (Fig. 43C). The long rectum ends in a gaping anus.

The gonads lie in a row on each side of the ventral line (Fig. 43A). A row of flasked-shaped testes, of variable size (Fig. 43B), is not always well aligned on the left side. On the right, there are testes in the anterior, hermaphroditic gonads at the level of the gut, and some testes in the extreme posterior (Fig. 43B). The number of hermaphroditic gonads varies between zooids. The colonies are not fully mature, and are not brooding larvae. In young specimens, the progressive gonadal development can be observed (Fig. 43D–F) on both sides of the body, each gonad lobe consisting of two vesicles with a single aperture (Fig. 43E, F). The posterior vesicle regresses rapidly on the left side, while it develops into the ovary on the right side (Fig. 43F). We did not observe oviduct formation.

There are few endocarps and no cloacal tentacles.

Remarks and distribution

Stolonica as a genus *sensu stricto* forms an homogeneous group. *Stolonica multitestis* sp. nov. is the first species of the genus collected in South Africa. The South African species is characterized by unlobed testes, a stomach slightly elongated, and a large number of testes on the left side with short ducts.

Gynandrocarpa placenta (Herdman, 1886)

Figs 4G, 44

Goodsiria placenta Herdman, 1886: 328, pl. 43 (figs 1–10), pl. 44 (figs 4, 8–10).
Goodsiria placenta fusca Herdman, 1886: 326, pl. 44 (figs 5–7).
Gynandrocarpa placenta unilateralis Michaelsen, 1900: 29.
Gynandrocarpa placenta fusca: Michaelsen, 1900: 29.
Gynandrocarpa domuncula Michaelsen, 1902 (*nomen nudum*); 1904*a*: 247, pl. 11 (fig. 14), pl. 13 (fig. 58).
Gynandrocarpa unilateralis: Millar, 1962: 178, fig. 27; 1964: 166.
non *Polyandrocarpa placenta*: Millar, 1955: 199, fig. 26 (= *Polyandrocarpa* sp.)

Material

Two colonies, Miller's Point, False Bay, 15 m depth; Oudekraal, 6 m depth (Griffiths coll.).

Description

This abundant species has the characteristic shape of an 'elephant ear'. It has a double layer of zooids held erect on a short peduncle of massive tunic tissue. Among colonial styelid species, pedunculate ones are the less common. The zooids are pink in life and three-quarters of their length is enclosed in a thick fibrous tunic. The zooids (Fig. 44A, B, C) are 6–8 mm long and enclosed in a tunic capsule. The siphons are close together. The body wall is thin with muscles regularly distributed over the entire body. Pigment flecks are found everywhere. There are 20–40 stout, curved oral tentacles arranged irregularly in 3–4 orders. The prepharyngeal band has two parallel rims and forms a low dorsal 'V'. The dorsal tubercle is button-shaped and opens in a simple hole. The dorsal lamina is high but rather short. The endostyle does not extend beyond the postero-ventral side of the body and turns into a long retropharyngeal band where most of the longitudinal vessels end. The oesophagus entrance is two-thirds of the way down the branchial sac.

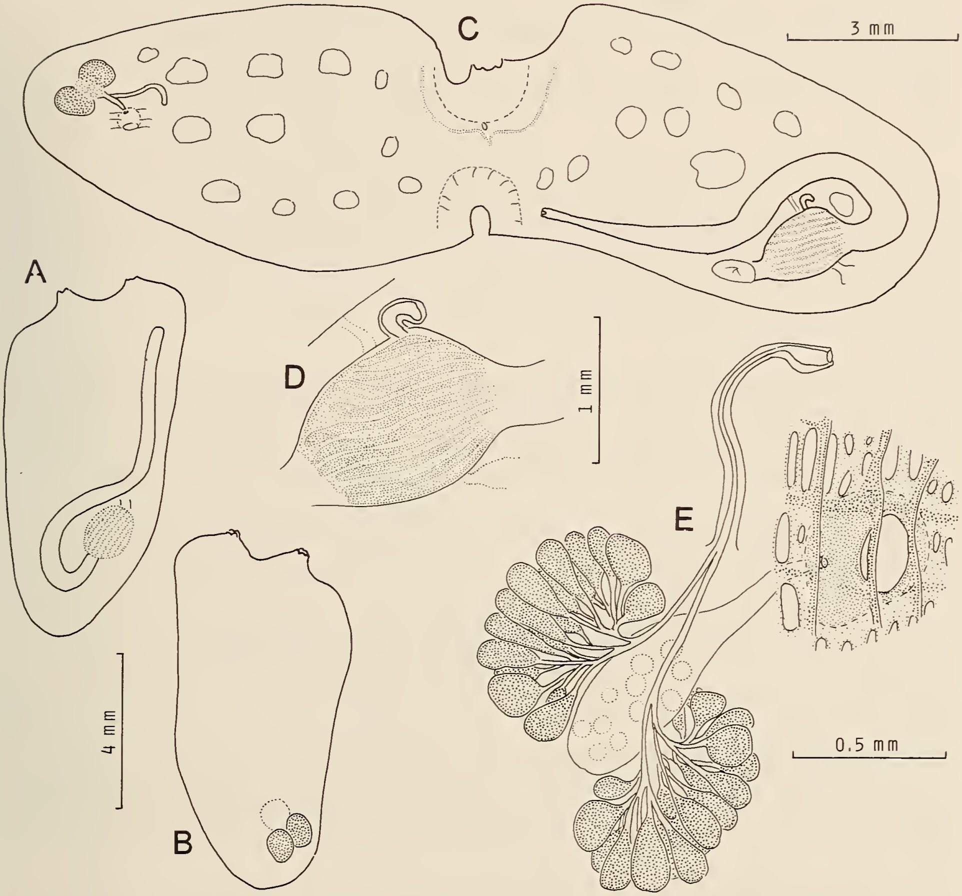

Fig. 44. *Gynandrocarpa placenta*. A. Left side of a zooid. B. Right side of a zooid. C. Zooid opened along the ventral line. D. Stomach. E. Gonad with the oviduct leading into the incubatory pouch.

The branchial sac has three folds on each side. The third fold on the left side is always smaller than the others, variable between the individuals, and does not reach the posterior part of the branchial sac. The branchial formula is:
R.E. 2 (4) 3 (5) 6 (6) 1 D.L. 2 (6) 3 (5) 3 (2) 2 E. L.

The first vessel on the left side remains parallel with the dorsal lamina down to the oesophagus entrance. The stigmata are short and without parastigmatic vessels. There are, on average, five stigmata in a mesh between the folds and 2–3 on the folds.

The gut (Fig. 44C, D) is linked to the body wall only by trabeculae. The ovoid stomach has about 20 longitudinal grooves. The caecum (Fig. 44D) is hook-shaped and arises at a point two-thirds down the stomach. The secondary intestinal curve is not accentuated. The rectum is long; the anus has four lobes or a plain edge.

The gonad (Fig. 44E) is characteristic of the genus. It lies at the bottom of the cloacal cavity on the left side of the body (Fig. 44B) and is partially enclosed in the body wall. The ovary is centrally placed between two long testis masses. The sperm ducts join to form a very long papilla ending in an ampulla (Fig. 44E).

The oviduct opens against a peculiar structure of the branchial tissue forming an incubatory pouch (Fig. 44E). This pouch is hemispherical and opens between two longitudinal vessels. No larvae are present in the colonies. The body wall bears large endocarps. About 15 cloacal tentacles are particularly long.

Remarks

Sometimes a dromiid crab digs its hole in the peduncle of the colony and then carries it on its carapace like a 'cloak'. It would be interesting to know at which stage of development this association begins, and whether the crab removes a piece from a mature colony or a young colony from the substratum to clothe itself.

The nomenclature for this species is complex. We have examined the type specimen from the British Museum. Herdman (1886) described the species from Simon's Bay. The single gonad is precisely figured in his cross-section figure (pl. 44 (figs 4, 8, 9)) but in the text Herdman used the plural when referring to the gonads and this has caused numerous confusions. He did not mention that the gonad lies on the right side of the body. Herdman also described the variety *G. placenta fusca* in the same publication. It only differs in the shape of the colony, which is less elongated and wider than in the type specimen.

Michaelsen (1900) redescribed the type and created the genus *Gynandrocarpa* based on the gonad disposition. He recognized Herdman's variety *G. placenta fusca* and designated *Gynandrocarpa placenta unilateralis* as the type of the species.

Stebbing (1902: 26) found colonies associated with Dromiidae and correctly identified them as *Goodsiria placenta*.

Michaelsen (1902), in a publication about symbiosis, cited Stebbing's specimens under the name *Gynandrocarpa domuncula*, *nomen nudum*, a name that he formally created later (1904*a*: 247, pl. 10 (fig. 14), pl. 13 (fig. 58)). He recorded this species from the Agulhas Bank at 100 m depth and from Dar es Salaam at 400 m. The same year, Michaelsen (1904*b*) described *Gynandrocarpa placenta* and *Gynandrocarpa domuncula*, differing in colony shape only, one of them being free-living on the bottom, the other settling on a crab. He abandoned the distinction between *G. placenta fusca* and *G. placenta unilateralis*. In an appendix to the same paper (p. 114) he noted the presence of this species in KwaZulu-Natal.

Herdman (1912) recorded *Goodsiria (Gynandrocarpa) placenta* from the Falkland Islands without giving further details.

Millar (1955) upset everything by describing a true *Polyandrocarpa* that he named *Polyandrocarpa placenta*. In 1962, having found the 'elephant ear', he referred it to *Gynandrocarpa unilateralis* Michaelsen, 1900, and compiled the correct description of Herdman's species.

Kott (1969) assigned the name *Polyandrocarpa placenta* sensu Millar (1955) to Herdman's specimens from the Falkland Islands without seeing the specimens.

We have not been able to find Millar's specimens (1955) in museums; apparently they correspond to a new species.

Remarks on the genus Dextrocarpa *Millar, 1955*

In 1955, Millar described the genus *Dextrocarpa*, which has a gonad similar to that of *Gynandrocarpa*. He considered (p. 203) that the genus *Dextrocarpa* issued from the genus *Gynandrocarpa* by the 'loss of budding power and may be regarded as one of the most specialized genera of the Polyzoinae'.

Later (1962, 1988) he found aggregated zooids and assumed that they were budding.

Another species of the genus, always solitary, was recorded at Kerguelen (Monniot, C. 1978). More recent data about the budding of colonial Styelidae and the possible existence of budding in the genus *Polycarpa*, are persuasive evidence that *Dextrocarpa* is a synonym of *Gynandrocarpa*.

***Polyandrocarpa griffithsi* C. Monniot sp. nov.**

Fig. 45

Material

Holotype. SAM–A25860, Isipingo, KwaZulu-Natal (30°00'S 30°57'E), from rock pools. Collected by C. L. Griffiths, 10 July 1996. Unique.

Description

Live specimens are reddish and entirely covered with sand, making compact blocks to which many other ascidians, such as *Polyclinum*, *Molgula* and *Botryllus gregalis* are attached. The tunic is embedded with sand and thus stiff and brittle. It is possible to separate the individuals almost to their base. They vary in size within a block. The reflex tunic within the long protruding siphons is not coloured.

The body wall is thin, translucent (Fig. 45A, B) and easily torn. Musculature is limited to the siphons. Both siphons have a large velum. About 60 short and flat oral tentacles, in three orders, arise from a protruding crest. There is a large space between the tentacles and the prepharyngeal band. The latter has only one high rim, with a slight dorsal curve. The protruding dorsal tubercle varies in shape, forming either a 'C' that opens to the anterior or a slit with a variable opening (Fig. 45D). The dorsal lamina is shorter than the endostyle, and rises progressively higher to end abruptly adjacent to the first branchial fold on the left at the oesophageal entrance.

The thin branchial sac has four folds on each side. Anteriorly we counted:
R. E. 6 (10) 5 (10) 4 (12) 3 (10) 2 D. L. 2 (10) 3 (12) 4 (10) 5 (9) 1 E. L.

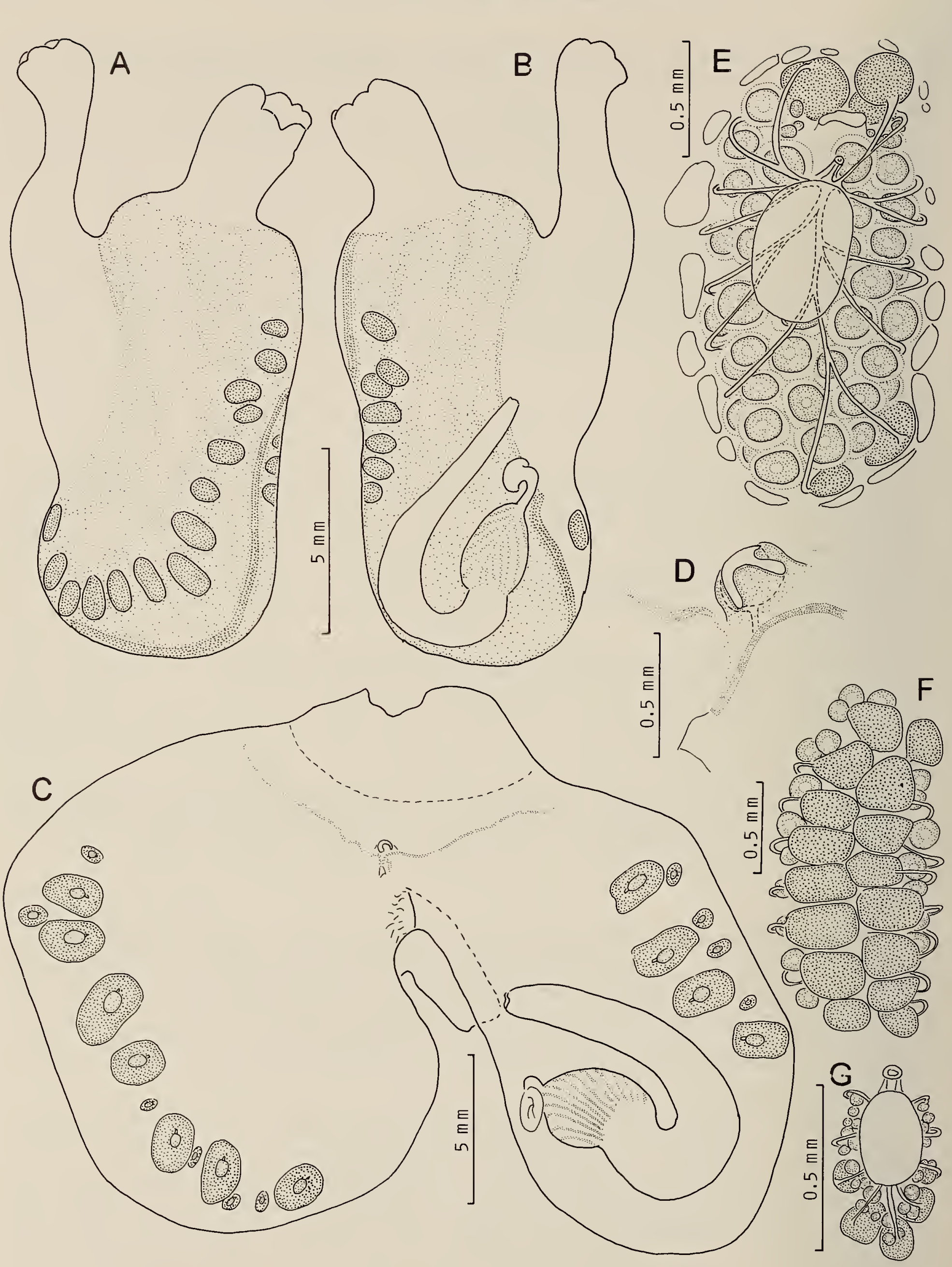

Fig. 45. *Polyandrocarpa griffithsi* sp. nov. A–B. Both sides of a zooid. C. Zooid opened along the ventral line. D. Dorsal tubercle. E. Internal side of a mature gonad. F. External side of a gonad. G. Young gonad with a large central gland.

The first fold on the right moves away posteriorly from the dorsal lamina. The first longitudinal vessel on the right side runs parallel to the dorsal lamina; in the posterior part 3–4 intercalated vessels arise between the first vessel and the first fold. The folds are sharply cut at the oesophagus entrance. There are 4–5 elongated stigmata in a mesh between the folds, and 2–3 on the folds. They are regularly crossed by parastigmatic vessels.

The digestive tract is short and has no secondary curve (Fig. 45B, C). The oval stomach has about 20 grooves, many of them ending at the ventral midline of the stomach. The anus has a plain edge or four low lobes.

The gonads, arranged in a row on each side of the endostyle (Fig. 45A-C), have a peculiar structure. They are enclosed in hollows in the body wall. In each polycarp the ovary lies over the testis lobes (Fig. 45E, F). The oocytes have a thick layer of clear follicular cells. The oviduct is short and wide. The ducts of the testis follicles join to form a protruding papilla (Fig. 45E). There is a round mass of clear tissue above each polycarp that is not related to the gonad ducts (Fig. 45C, E, G). Its role is unknown. A similar structure has only been found in *Polyandrocarpa glandulosa* Monniot, C., 1987, from New Caledonia. This tissue appears as soon as the gonads develop (Fig. 45G).

There are no endocarps. The cloacal tentacles are arranged in a ring at the base of the siphon.

Remarks

This species could possibly be confused with *Polycarpa anguinea* or *Polyandrocarpa anguinea* (Sluiter, 1898*a*), recorded from Knysna but not found during this collection. In both cases, the agglomerated zooids are covered with sand and their tunics are fused. The siphons are long and the body wall is thin without endocarps. The gut has an oval stomach and forms an open loop. The gonads alone are different.

We have examined the type specimen of *Polycarpa anguinea* in which the gonads are poorly developed. They are elongated polycarps that protrude into the cloacal cavity without any evidence of a central vesicle. Samples of *Polycarpa anguinea* according to Millar (1955) and of *Polyandrocarpa anguinea* according to Millar (1962) probably belong to Sluiter's species, as Millar's illustrations suggest.

Polycarpa insulsa (Sluiter, 1898*b*)

Figs 4H, 46

Styela (Polycarpa) insulsa Sluiter, 1898*b*: 14, pl. 3 (fig. 43).
Synonymy and distribution see Monniot, C., 1987: 296, fig. 9.

Material

One specimen. Isipingo, in rock pools (Griffiths coll.).

Description

This species is covered with algae and sponges. Some sand is embedded in the tunic. Live specimens have eight white bands in the interior of both siphons which disappear after preservation. When fixed the cloacal siphon becomes reddish with eight black external bands that do not exist on the oral siphon. The tunic is hard and about 1 mm thick.

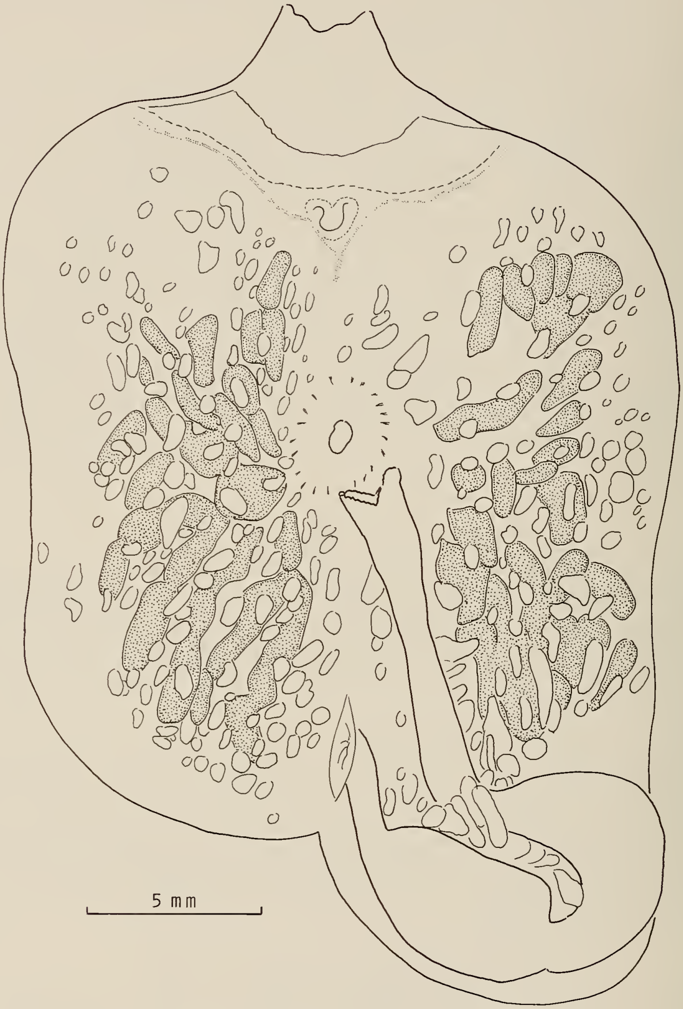

Fig. 46. *Polycarpa insulsa.* Internal anatomy.

The body wall is thick and opaque. About 50 oral tentacles are arranged in no clear order and with some smaller ones between them. The prepharyngeal band has two rims and a pronounced dorsal indentation. It is prolonged by a small groove (Fig. 46). The dorsal tubercle is large, protruberant, and opens as a 'U' with the sides curved to the exterior (Fig. 46). The dorsal lamina is long and low.

The branchial sac has four low folds on each side that do not cover each other. The branchial formula is:

R. E. 2 (10) 3 (14) 3 (13) 2 (20) 2 D. L. 1 (14) 4 (11) 4 (13) 3 (8) 2 E. L.

The exterior of the branchial sac is lined with fibrous tissue. The first vessel on the right side runs parallel to the dorsal lamina. The vessels are tightly compressed on to the folds.

The gut begins in the posterior part of the branchial sac. The enlarged stomach is long and has no obvious grooves. There is no caecum. The long rectum has a large diameter and ends with an anus that has two slightly undulated lobes.

The body wall is lined with a layer of fibrous and resistant tissue in which the protruding polycarps are wrapped. The polycarps are so close to each other that they seem attached to each other (Fig. 46). The genital ducts are short. There are numerous endocarps covering the whole surface of the body wall (Fig. 46). They are thin and brittle and not covered by the fibrous layer that they cross through small openings. There are very few, rather stout, cloacal tentacles arranged in a circle.

Remarks and distribution

Polycarpa insulsa is often characterized by black stripes on the exterior side of the siphons, but its most peculiar feature is the presence of a layer of extremely resistant, whitish, fibrous tissue that covers the internal body wall and extends slightly on to the exterior of the branchial sac. The specimen from Isipingo is very similar to samples from Martinique and New Caledonia. Small differences, such as the greater length of the intestine, may be due to the disposition of the animal on the substratum.

Polycarpa insulsa is widely distributed, extending from the western tropical Atlantic Ocean to KwaZulu-Natal, and New Caledonia.

Polycarpa mytiligera (Savigny, 1816)

Fig. 47A

Cynthia mytiligera Savigny, 1816: 98, pl. 8 (fig. 2).

For synonymy and distribution see *Polycarpa mytiligera*: Monniot, F. & Monniot, C., 1999: 29, text-fig. 17, pl. 3F. Additional synonymy: *Polycarpa seychellensis*: Monniot, C. & Monniot, F., 1976: 373, fig. 3A.

Material

Three specimens. Sodwana Bay, 15–35 m (Schleyer coll.).

Description

This large species may reach 100 mm across. It is characterized by a dorsal tubercle with numerous openings, at least in older specimens. There are four branchial folds on each side and the first on the right side runs parallel to the dorsal lamina. The gut occupies the posterior third of the body (Fig. 47A). The stomach is oval, has internal folds, and lacks a caecum. The wide anus has a slightly dented margin. About 100 gonads are irregularly distributed on the body wall (Fig. 47A). This species is rarely found with active gonads and, even when these are functional, they never protrude but remain hidden in the body wall. The cloacal siphon is encircled by fleshy crests and a row of very small cloacal tentacles.

Remarks and distribution

This species is abundant along the coasts of the Red Sea, Tanzania and Mozambique. It has affinities with a large group of tropical species that have gonads embedded in the body wall and bear endocarps only in the digestive loop.

Polycarpa rubida (Sluiter, 1898*a*)

Fig. 47B

Styela (Polycarpa) rubida Sluiter, 1898*a*: 53, pl. 7 (figs 1–4).
Polycarpa rubida: Millar, 1961: 11; 1988: 836. Monniot, C. & Monniot, F., 1976: 376, fig. 4.

Material

Several specimens, Sodwana Bay, KwaZulu-Natal, 15–21 m. (Schleyer coll.).

Description

This species is colloquially named 'the bloody tunicate' as it grows in irregular red masses. One finds among them individuals of all sizes from young buds to mature adults and pieces of wrinkled, hard tunic, the sole remnants of old specimens that have entirely regressed. The tunic is common to the whole mass. The zooids are either totally enclosed, with only the siphons protruding, or they are merely joined at their base, forming a small peduncle above a tunic mass. All levels of attachment may be observed in a single sample. The tunic is thick and leathery.

The body wall is opaque and has evenly distributed musculature. Both siphons possess a large velum. About 50 long, thin oral tentacles are arranged in 4–5 orders, and occasionally there are smaller ones between them. The prepharyngeal band has two rims forming a pronounced dorsal curve. The dorsal tubercle protrudes and occupies the whole dorsal curve. Its opening is variable in shape but usually S-shaped. The long dorsal lamina ends at the middle of the entrance to the oesophagus.

The branchial sac has four folds on each side:
R.E. 2 (11) 3 (16) 3 (15) 7 (16) D.L. 1 (12) 3 (15) 3 (15) 3 (12) 2 E.L.

The first longitudinal vessel lies parallel to the dorsal lamina. There are 6–8 elongated stigmata in a mesh between the folds and 2–4 on the folds. They are often cut by parastigmatic vessels.

The digestive tract has a secondary curve that is only slightly pronounced (Fig. 47B). The stomach is spindle-shaped and has a thin wall with grooves, which are sometimes more pronounced at the anterior. There is no caecum. The intestine ends in a petal-edged anus.

There is one row of gonads in a semi-circle around the cloacal siphon (Fig. 47B). Each gonad is slightly elongated and protrudes into the cloacal

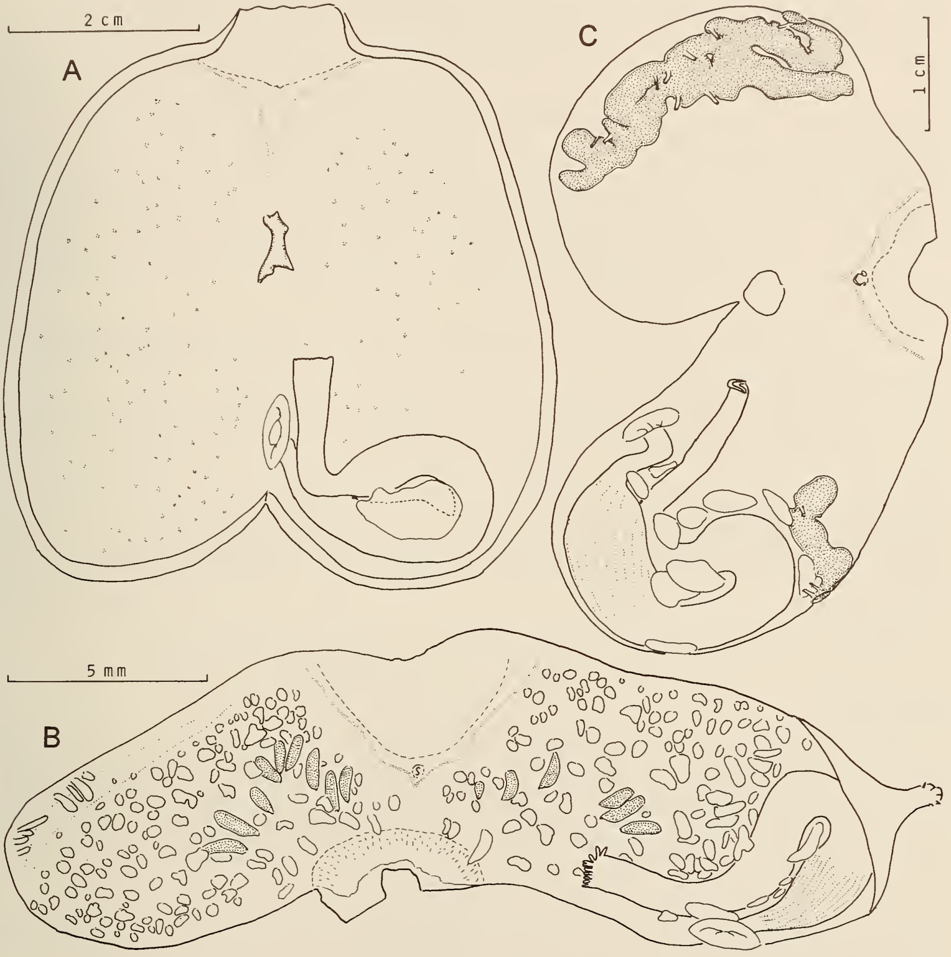

Fig. 47. A. *Polycarpa mytiligera*. B. *Polycarpa rubida*. C. *Cnemidocarpa humilis*.

cavity, but remains attached to the body wall along much of its length. The gonads were inactive in specimens collected in January and May.

Numerous endocarps are distributed over the entire body wall and between the two limbs of the gut (Fig. 47B). The cloacal tentacles arise from the velum.

There is a compact mass of undifferentiated tissue behind the gut that is used for regeneration and budding.

Remarks and distribution

It is with much hesitation that we ascribe this species to the genus *Polycarpa*, in spite of its colonial aspect. This species is mainly known from solitary individuals. It belongs to a species group that manifests regeneration and budding: *Polycarpa captiosa* (Sluiter, 1885), *P. papillata* (Sluiter, 1885), *P. olitoria* (Sluiter, 1890), and *P. madagascariensis* Michaelsen, 1912.

These species are characterized by closely spaced siphons, elongated gonads in a single row within the middle of the body wall, numerous endocarps, and a gut loosely attached to the body wall with a clearly striated stomach. All the species have the ability to shed and regenerate the branchial sac and gut. This phenomenon is more or less pronounced according to the species, from an accidental to obligatory evisceration. Generally, these species are only able to develop gonads after evisceration. After a zooid releases its genital products, it regenerates either into a new zooid or into several more or less separate cloned zooids, as in *P. papillata*, or an aggregation of cloned zooids, as in *P. rubida*.

No specimens with mature gonads were recorded in *P. rubida* and few in other species of the same group.

Polycarpa rubida has been recorded from Mozambique to KwaZulu-Natal.

Cnemidocarpa humilis (Heller, 1878)

Fig. 47C

Styela humilis Heller, 1878: 26.
For synonymy and distribution see *Asterocarpa humilis* in Kott, 1985: 141, fig. 65.

Material

Several specimens. Hout Bay Harbour, on ropes (Monniot coll.).

Description

The specimens are globular and attached to the substratum on their posterior left side. The siphons are slightly protruding and circled by papillae. When contracted, the siphons retract deeper than the papillae. The tunic is thin, soft but resistant. The largest individuals (60 mm) are covered with various epibionts, including even mussels.

Young specimens are slightly translucent and pink. Internal muscles are visible through their body wall and so is the diffuse circular musculature issuing in radial ribbons from both siphons. About 40 irregularly developed oral tentacles are distributed in four orders on a muscular rod. In one specimen, parasitic ciliates caused a ramification of the tentacles. Only a few of these ramifications have ciliates on their tips. The prepharyngeal band has two rims, the anterior one being irregular and the posterior more developed. There is a deep dorsal indentation without scalloping at the level of the branchial folds (Fig. 47C). The dorsal tubercle is a protruding button, open at the anterior in a simple 'C' in young individuals but having a double spiral rolled to the exterior side in old specimens. A plain dorsal lamina progressively tapers and ends at the oesophagus entrance. The endostyle is attached to the body wall by a raised and thin membrane or long trabeculae.

The thin branchial sac has four low folds per side. It is linked to the body wall by particularly numerous dermato-branchial bridges. We counted:
R.E. 4 (7) 3 (8) 3 (8) 3 (8) 0 D.L. 0 (9) 3 (8) 3 (6) 3 (5) E.L.

There is no sinus between the dorsal lamina and the first folds. There are 15–20 stigmata in a mesh between the folds and 3–10 on the folds. The stigmata are small and often intersected by parastigmatic vessels.

The stomach is dilated and soft with some internal grooves. There is no caecum. The intestinal wall is transparent and has a well-marked typhlosole. The horseshoe-shaped anus has a curled rim. The gut is surrounded by endocarps (Fig. 47C).

In young individuals the gonads are well separated with 4–6 on the right side and two on the left side. The gonads become ramified during growth and join to form a single mass (Fig. 47C) crossing the line of the endostyle. The number of sperm ducts increases as the gonads develop, opening through large papillae scattered over the gonads. The oviducts are less numerous and hardly visible.

Remarks and distribution

Kott (1985) illustrated Australian specimens as having ramified gonads that remained independent from each other. The samples from the Magellanic region have united gonads, as in the present collection. All other characteristics, the branchial sac, the gut, and the endocarp disposition, are identical. This species is common in natural habitats in New Zealand, southern Australia and the southern end of South America. It is surprising that a species of such large size has only been collected in harbours in South Africa. It may have been introduced.

Styela angularis (Stimpson, 1855)

Fig. 48

Cynthia angularis Stimpson, 1855: 387.
Tethyum costatum Hartmeyer, 1911: 564, pl. 47 (fig. 8), pl. 57 (figs 11–12).
Styela costata: Hartmeyer, 1913: 133. Michaelsen, 1915: 379. Millar, 1955: 204, fig. 29.
Styela angularis: Hartmeyer, 1927: 189. Millar, 1962: 190; 1964: 175.

Material

Several specimens, Oudekraal, Cape Peninsula, 10 m (Griffiths coll.).

Description

This pedunculate species has a characteristic hexagonal cross-section; it can exceed 100 mm in height. The cloacal siphon is terminal and the oral siphon opens a short distance to the ventro-posterior. Both have four lobes. The stiff tunic is often covered with epibionts, among them ascidians. The body without the tunic is cylindrical. The body wall is opaque and contains a strong musculature. A bunch of vascular processes emerges at the body extremity and enters the peduncle (Fig. 48). The body wall is not prolonged into the peduncle. There are about 60 oral tentacles that alternate in four orders of size, those of the fourth order being of variable size. The tentacles are triangular in cross-section and have sharp edges.

The prepharyngeal band has two raised blades that are close to each other; it describes curves with no relation to the branchial folds. There is no dorsal 'V'. The dorsal tubercle is large, protruberant and opens in a 'C'. The

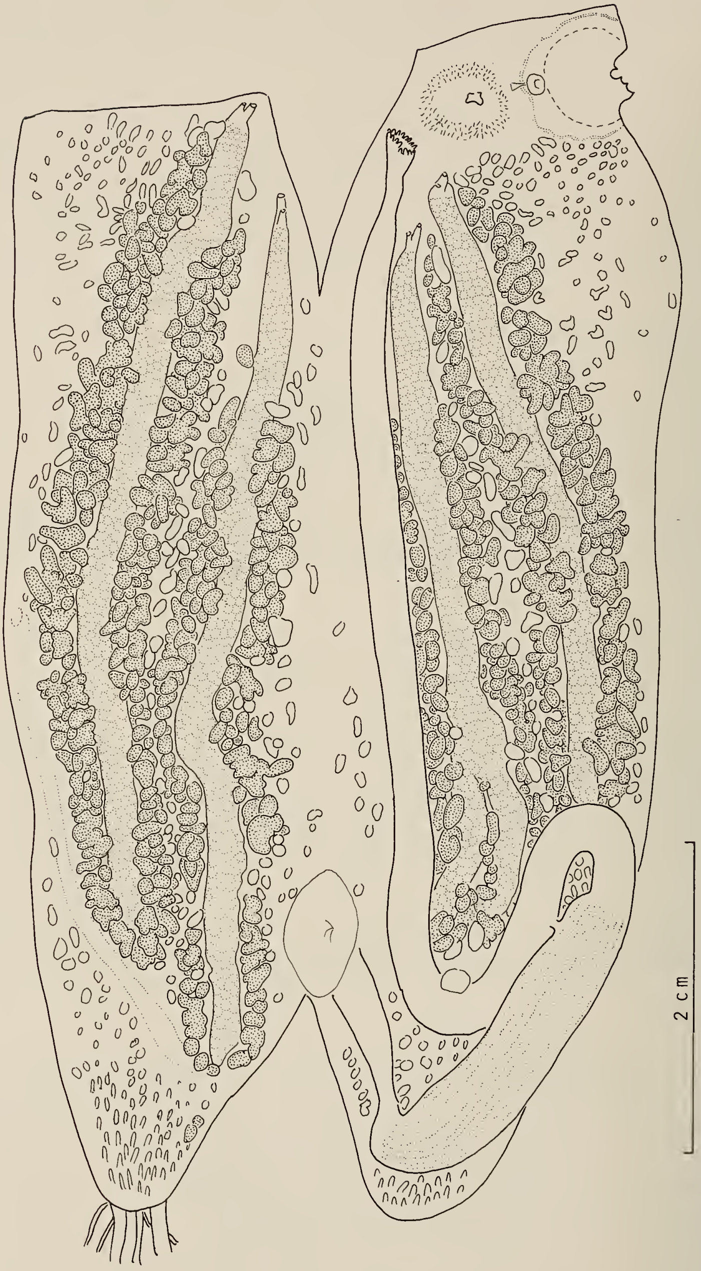

Fig. 48. *Styela angularis.*

dorsal lamina is long and has a smooth margin; its height is clearly greater than that of the branchial folds. We counted on the right side:
R.E. 7 (9) 12 (17) 11 (18) 12 (25) 7 D.L.

The longitudinal vessels are closely spaced on the folds and almost joined at the top of the branchial sac. The branchial meshes are square or longitudinally extended. They contain 4–5 long stigmata near the endostyle and 2–3 between the folds.

It is impossible to see stigmata on the folds. Parastigmatic vessels are only apparent when a row is dividing and on the sides of the folds.

The oesophagus entrance is before the bottom of the branchial sac. The wide stomach has internal parallel ridges (Fig. 48). Half the length of the oesophagus and the stomach are located below the bottom of the branchial sac. There is no caecum, but a bridge of tissue unites the stomach and the intestine and contains the pyloric ducts. The intestine curves after the stomach and follows the dorsal lamina for a considerable distance towards the cloacal siphon (Fig. 48). The narrow rectum is not attached to the body wall, and ends in a funnel-like anus with a fringed margin.

There are two long, straight gonads on each side of the body (Fig. 48). The ovaries are cylindrical and attached to the body wall, with the minutely divided testis lobes located on either side. The sperm ducts run down the internal side of each ovary. The oviducts are deeper, lying next to the body wall.

Some testis lobes may be far from the extremity of the ovary in the posterior of the body. The protruding female genital papillae open near the cloacal siphon behind the anus.

The voluminous heart is adjacent to the endostyle. There are some endocarps between the gonads, numerous near the oral siphon and even much more numerous in the posterior extremity of the body, where they become elongated (Fig. 48). The cloacal siphon has a ring of small tentacles.

Distribution

This species extends from Lüderitzbucht, Namibia, to the Eastern Cape.

Styela canopus (Savigny, 1816)

Fig. 49A

Styela canopus Savigny, 1816: 45, 154.
Styela partita (Stimpson, 1852) aut. mult.
Styela canopus: Kott, 1985: 112, fig. 48, and distribution.
Styela pupa Heller, 1878: 107, pl. 2 (fig. 13). Millar, 1955: 204, fig. 30.
Tethyum pupa: Hartmeyer, 1911: 569, pl. 5 (figs 1–7).
Tethyum canopus malgalhaense: Hartmeyer, 1911: 522, pl. 57 (figs 18–20).
Styela marquesana: Millar, 1955: 207, fig. 32.
Styela stephensoni Michaelsen, 1934: 157, figs 4–7. Millar, 1964: 175, fig. 12.
?*Styela aequatorialis*: Millar, 1955: 201, fig. 33.

Material

Several specimens. False Bay; Kommetjie; Port Elizabeth (Monniot coll.).

Description

Ascidiologists have, for about 20 years, remarked on the great environment-dependent variability of this species. Large specimens, 20–30 mm in size, live in sheltered environments such as mangrove swamps in the same geographic area as smaller specimens that live on rocky shores and have a tunic with ridges and tubercles. Very small individuals less than 10 mm in size and covered with sand inhabit sandy bottoms. All intermediates are found in the same area. The three principal variants were described by Millar (1955) under three different names.

All samples have in common a cylindrical elongated stomach with well-formed folds (Fig. 49A), a small caecum, a large intestine that is always curved, and two gonads on each side (Fig. 49A). One of the gonads may be missing on the left side in small specimens, and large specimens may have three gonads on the right side. Each gonad normally consists of a sinuous ovary with testis lobes adjacent but not adhering to it. In small specimens, there are often only a few testis lobes, whereas in larger animals they become numerous. The endocarps are rare in small specimens that are covered with sand.

Distribution

Styela canopus has a wide distribution, and occurs in natural habitats in shallow coastal regions, as well as extending into harbours and on to wrecks.

Styela materna Monniot & Monniot, 1983

Fig. 49B, C

Styela materna Monniot, C. & Monniot, F., 1983: 81, fig.17 c, d.

Material

Three specimens. Miller's Point, False Bay, 2 m (Monniot coll.).

Description

Three specimens (less than 10 mm across) were collected in a cavity in a calcareous seaweed. The tunic is wrinkled on the dorsal side and has some brown-ochre scales. The tunic is lighter and contains some sand on the ventral side. The siphons are close to each other and do not protrude. This species is very similar in external appearance to *Styela canopus*.

The muscles are strong but not gathered in bundles. There are about 20 stocky tightly-packed oral tentacles that do not alternate precisely. The prepharyngeal band is thin and consists of a single crest. It is only slightly indented dorsally. The dorsal tubercle protrudes and is urn-shaped. The dorsal lamina is thick, low and rather long. The branchial sac has four folds per side. We counted on the right side:

R.E. 0 (5) 1 (6) 1 (6) 2 (8) 2 D.L.

The longitudinal vessels on the right of the dorsal lamina run parallel with it. We counted 5–6 stigmata per mesh between the folds and 2–3 on the folds. The stigmata are rows regularly cut by a strong parastigmatic vessel. The digestive tract (Fig. 49B) is long. The cylindrical oesophagus opens into a wide and elongated stomach that has a thin wall with about 15 well-marked grooves. No caecum was found. The intestine ends in a narrow anus with small lobes.

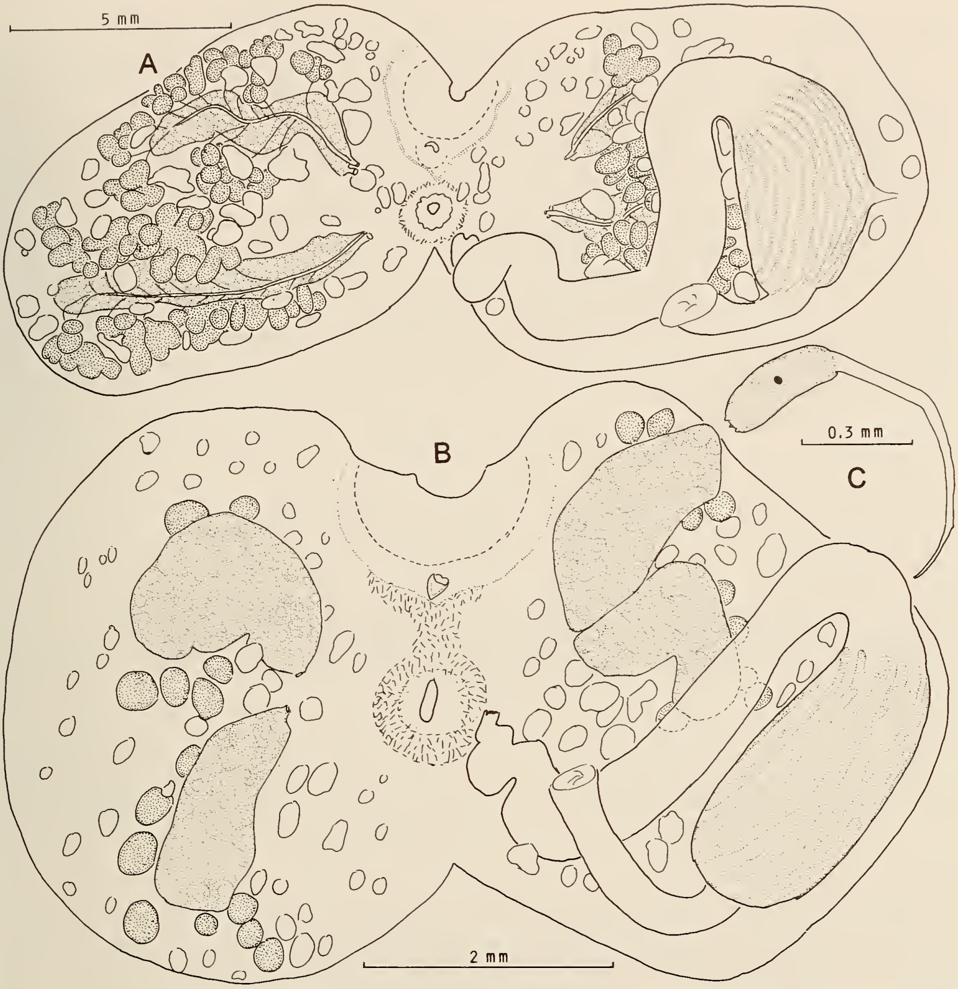

Fig. 49. A. *Styela canopus*. B. *Styela materna*. C. Tadpole of *Styela materna*.

There are two short, protruding ovaries on each side (Fig. 49B). The oocytes are compacted and have a polygonal shape. Some round testis lobes are loosely associated to each ovary (Fig. 49B). The sperm ducts are very thin and short and difficult to see even after staining. The genital ducts are very short.

There are numerous endocarps on the body wall (Fig. 49B). The cloacal siphon has a short velum and a dense circle of cloacal tentacles on a wide ring. This ring extends anteriorly as a dense tentacular field to reach the prepharyngeal band (Fig. 49B).

Styela materna has the rare attribute in the genus of brooding its eggs. Larvae (Fig. 49C) are numerous in the cloacal cavity. Their trunks measure 370 μm in length and 19 μm in width; the notochord is 760 μm long and only rarely is a membrane found around it. The larvae have three anterior adhesive papillae and one sensory organ.

Remarks and distribution

This species was previously recorded from South Georgia at 66–180 m depth. The type specimens are larger than the South African material, 12 mm instead of 6–7 mm, and thus have male gonads more developed. The testis lobes in those specimens are tightly compressed and clearly have genital ducts. The branchial sac in the South Georgian specimens have up to 20 vessels in a fold. These differences are insufficient to erect separate species.

On the other hand, the similarities with *Styela canopus* are disturbing and include the gut shape, gonads and branchial sac. Larval brooding in *S. materna* is the only characteristic that allows the separation of the species from the multiple forms of *S. canopus*. Brooding remains an exceptional feature in the genus *Styela*.

Family **Pyuridae**

Microcosmus oligophyllus Heller, 1878

Figs 50A, 51A

Microcosmus oligophyllus Heller, 1878: 101, pl. 3 (fig. 21). Hartmeyer, 1912: 247, pl. 41 (figs 1–3). Millar, 1955: 211, fig. 36; 1962: 196, fig. 38.

Microcosmus oligophyllus wahlbergi Michaelsen, 1921: 2, pl. 1 (figs 8–9). Michaelsen, 1934: 161.

Material

Two specimens. Miller's Point, False Bay, and Gerickespunt (Sedgefield), low tide (Monniot coll.).

Description

The specimens are 10–30 mm across and have a thick, hard tunic with a dark red, wrinkled surface partially covered with epibionts. The siphons protrude slightly and are close to each other. The body is often irregular in shape as the tunic penetrates rock crevices. The tunic, 1–2 mm thick, has a white interior surface. The siphon spines (Fig. 51A) are spaced far apart. They are sharply pointed and have enlarged bases. The musculature is strong, made of ribbons in an almost continuous layer except above the endostyle and under the gut. The siphon sphincters are particularly strong, and are up to 2 mm thick. Both siphons have an internal velum consisting of two layers, the outer one stiff and the inner one thin and bearing thin filaments. The internal velum forms four pockets in the oral siphon. There are 24 stout oral tentacles in three orders of size, with two sets of ramifications. The prepharyngeal area has raised papillae (Fig. 50A). The prepharyngeal band has two crests and curves in a dorsal 'U'. The dorsal tubercle is large, slightly protruding, with horns internally rolled. The dorsal lamina is long and low, encircling the oesophagus entrance.

The branchial sac has five high folds on each side. We counted:

R.E. 0 (9) 3 (15) 3 (18) 3 (17) 3 (22) D.L. 2 (22) 3 (17) 3 (19) 3 (17) 3 (11) 0 E.L.

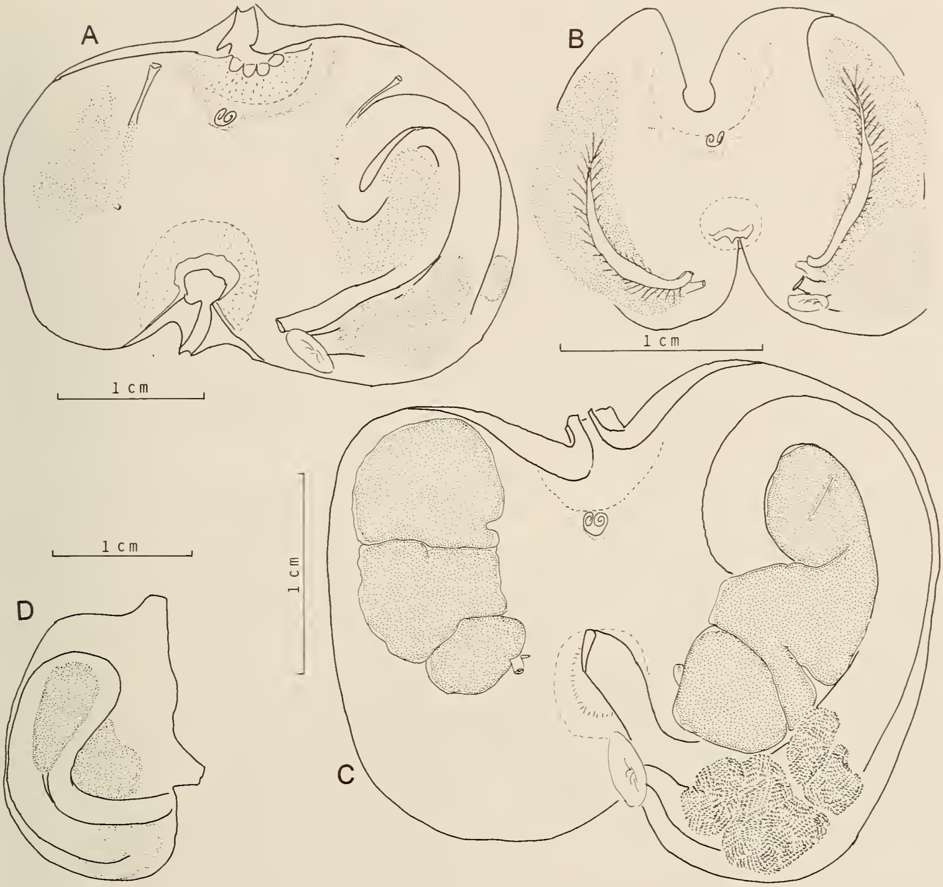

Fig. 50. A. *Microcosmus oligophyllus*. B. *Microcosmus psammophilus*. C–D. *Microcosmus squamiger*.

Most ventral folds do not reach the posterior of the branchial sac. The dorsal lamina has a wide unperforated band on the right side that is crossed by wide transverse vessels. On average there are seven longitudinal vessels in a mesh between the folds and 3–4 on the folds. They are sometimes intersected by parastigmatic vessels. The stigmata are short.

The gut and the gonads are wrapped in a loose tissue that obscures their outline. The stomach is wide and covered with two lobes of an hepatic gland (Fig. 50A). The one closest to the oesophagus is the largest, and it is also enclosed in the loose tissue. The hepatic lobes are wrinkled and lack protruding papillae. The intestine forms a loop in which the two limbs are closely apposed (Fig. 50A). The smooth anus is located at the oesophagus entrance.

The gonads were not fully developed and consisted of poorly defined masses inside the body wall. The gonad on the right side is in an anterior position; the one on the left side does not cross the gut (Fig. 50A) as in other *Microcosmus* species, as there is no room for it. The sperm ducts are directed towards the cloacal siphon as is usual. The oviducts are curved along the ventral side of the ovary and reach the anterior part of the body, a unique arrangement in the family Pyuridae. In all specimens, a large brown inclusion was observed in the heart.

Microcosmus oligophyllus is characterized by its five branchial folds and gonad morphology. The subspecies described by Michaelsen (1921) was only based on a different number of longitudinal branchial vessels, and he later hesitated about its validity (Michaelsen 1934).

Distribution

Microcosmus oligophyllus has only been recorded from South Africa.

Microcosmus psammiferus C. Monniot sp. nov.

Figs 50B, 51B, C

Material

Holotype. SAM–A25861, from wreck on Mossel Bay beach (34°12'S 22°08'E), collected by C. and F. Monniot, Feb 1996.

Other material. Two specimens, locality data as above (Monniot coll.).

Description

The three aggregated specimens are entirely covered with sand. They may have been slightly attached to the substratum or were free-living in sand. On the contracted animals, the siphons reveal themselves only by reddish tunical papillae. The siphons have a purple exterior tunic and an internal lining with eight alternating red and yellow bands. The siphon spines (Fig. 51B, C) are of two types. Those at the edge of the siphon are sharp, 25 μm long and tightly packed (Fig. 51B). Those more internal are pedunculate, urn-shaped and 35 μm long (Fig. 51C). Both kinds of spines are usually separated (Fig. 51B) but may be intermixed where they meet. Over the body, the tunic is whitish, thin, and the outer layer is encrusted with sand and bears short rhizoids 0.5 mm long. Most of the digestive tract and the gonads are located on the ventral side (Fig. 50B). There are 16 large oral tentacles in three orders, with numerous ramifications.

The prepharyngeal band has a single crest and is dorsally indented. The dorsal tubercle is large and protruding, with an anterior aperture and internally rolled horns. The dorsal lamina is anteriorly low with a smooth edge, and posteriorly higher with an irregularly dented rim. It joins a smooth annular crest that encircles the oesophagus entrance.

Fig. 51 *(see facing page)*. A. Siphonal spinules of *Microcosmus oligophyllus*. Scale bar = 20 μm. B–C. Siphonal spinules of *Microcosmus psammophorus*. A. Limit between the sharp distal spines of the siphons and the most internal urns. Scale = 50 μm. C. Detail of the urns. Scale = 20 μm. D–E. *Microcosmus squamiger*. Scales, D = 50 μm, E = 10 μm. E. *Pyura stolonifera*. Scale bar = 20 μm.

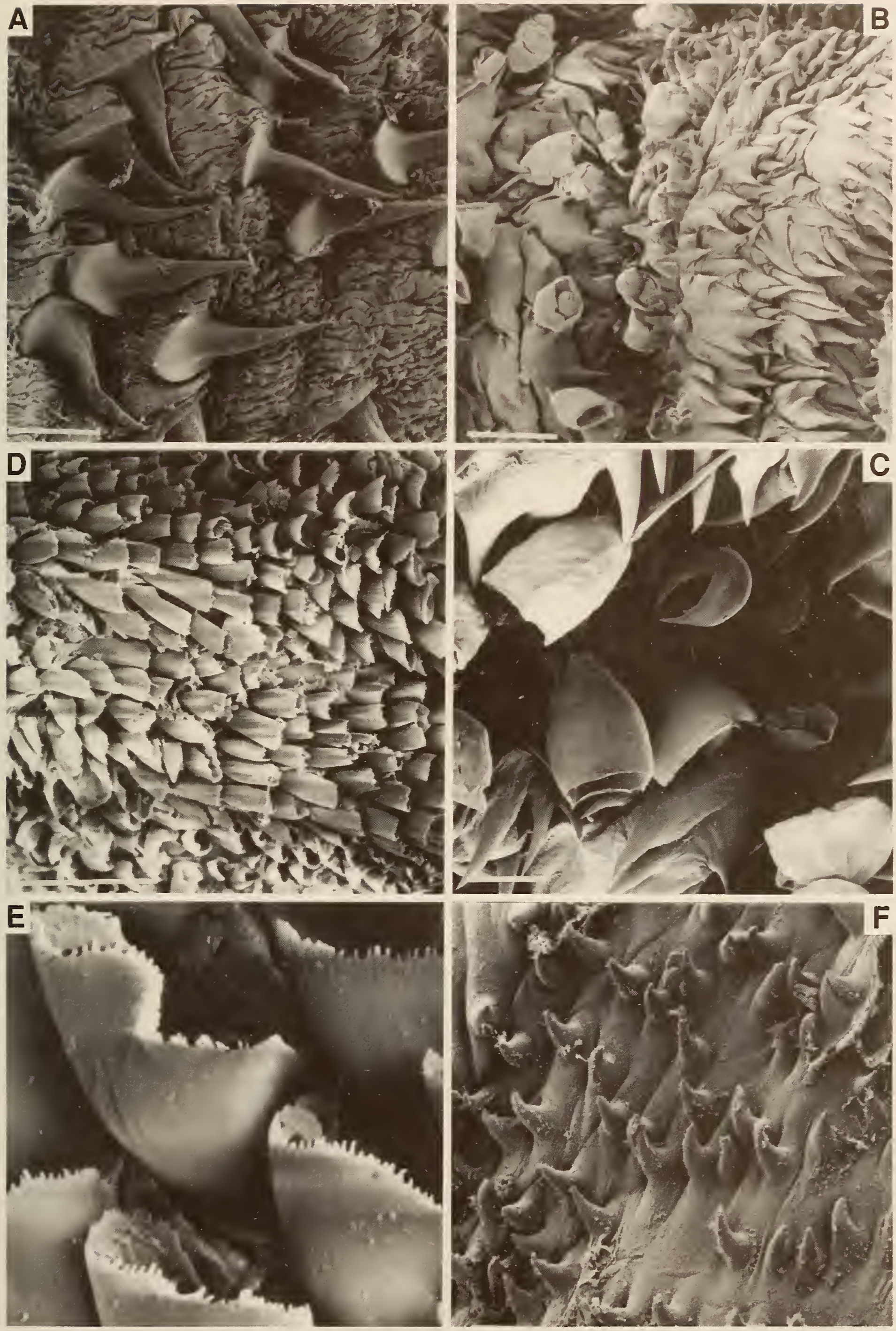

Fig. 51

The branchial sac is small relative to the body. The endostyle is obscured from the ventral side by the intestine and the right gonad that are close to each other, and only separated by a voluminous heart. The endostyle adheres to the stomach and the intestine.

The branchial sac has six folds. We counted:
R.E. 1 (12) 3 (18) 1 (18) 2 (15) 2 (12) 2 (18) 0 D.L. 0 (19) 2 (10) 1 (19) 1 (19) 0 (17) 2 (12) 1 E.L.

The branchial formula is rather irregular as the number of longitudinal vessels between the folds varies, some of them appearing irregularly. The stigmata are obviously coiled at the top of the branchial folds. A single coiled stigma occupies the area between the axial longitudinal vessel of the fold and the first or second vessel on the side of the fold. The stigmata are only cut at the level of the transverse vessels, from the third longitudinal vessel on the sides of each fold.

The gut loop is narrow with parallel limbs. The oesophagus is short. The large hepatic gland is not erect and consists of whitish tissue with low ridges. The rectum is short and the anus has a smooth edge and opens at the level of the oesophagus entrance.

There is one gonad on each side (Fig. 50B) with an unusual morphology for the genus *Microcosmus*. The cylindrical ovary is surrounded by a mass of testis lobes. Very numerous sperm ducts join a common sperm duct that lies against the ovary and almost conceals it at its terminal end. The left gonad crosses the intestine, and the testis internally covers a large part of the intestine, and the hepatic gland, in a thin layer.

There are no endocarps and no cloacal tentacles. The velum is higher dorsally.

Remarks

This species belongs to a group that is actually intermediate between the genera *Microcosmus* and *Hartmeyeria*. The genus *Hartmeyeria* Ritter, 1913, has few species: *H. triangularis,* the type species of the genus from Alaska; two Japanese species *H. orientalis* Oka, 1929, and *H. chinensis* Tokioka, 1967; the Atlantic *H. hupferi* (Hartmeyer, 1909); and *H. bouilloni* Monniot, C. & Monniot, F., 1976*a*, from Mozambique. The specimen described by Millar (1962) under the name *Microcosmus pedunculatus* Pérès, 1951, probably corresponds to *H. bouilloni*. These five species have in common: spiral stigmata at the top of the folds, the second fold being reduced to one vessel; muscles with a peculiar distribution; and a naked peduncle arising from the ventral side of the body wall through a 'button-hole'. This group is very homogeneous.

Hartmeyeria monarchica Hartmeyer, 1922, from Aden, is insufficiently known; it has a similar branchial sac.

Cynthia formosa Herdman, 1882 (and its synonym *Microcosmus spinifera* (Herdman, 1899)) does not belong to the genus *Hartmeyeria* as Kott (1985) suggested, but is closer to *Microcosmus psammiferus* sp. nov. Millar (1966), who had encountered the genus *Hartmeyeria* in western and southern Africa, considered this species to be a *Microcosmus*.

The two species *M. formosa* and *M. psammiferus* differ in their appearance, but have coiled stigmata at the top of the branchial folds, a second branchial fold that is not reduced to a single vessel, no characteristic peduncle, and the tunic is not embedded with sand, as it is in the true *Hartmeyeria* species. We consider that both species have somewhat peculiar characteristics for the genus *Microcosmus*, but our knowledge is not yet sufficient to justify their transfer to a new genus.

Microcosmus squamiger Hartmeyer & Michaelsen, 1928

Figs 50C, D, 51D, E

Microcosmus claudicans ssp. *squamifer* Hartmeyer & Michaelsen, 1928: 405.
see *Microcosmus squamiger* Kott, 1985: 356, figs 175e–f, 178.
Microcosmus exasperatus non Heller, 1878. Monniot, C. 1981: 59, fig. 1.
?Microcosmus exasperatus: Millar, 1955, fig. 35; 1962: 197.
Microcosmus squamiger: Lambert & Lambert, 1998.

Material

Two specimens. Knysna, on buoys (Monniot coll.).

Description

The specimens measure 30 × 20 mm and are attached on the left-posterior side. The siphons are closely spaced and protrude slightly. The colour is reddish brown. The tunic is leathery, often covered with epibionts, and nacreous on the interior. The siphonal spines (Fig. 51D, E), are 25 μm long and have the characteristic 'roof tile' shape of the species. They have spiny rims (Fig. 51E). The body wall is brownish and opaque. The musculature consists of ribbons in a layer that is continuous except under the gut.

There are 24 stout, very ramified oral tentacles distributed in four orders. The prepharyngeal area is narrow and covered with small papillae. The prepharyngeal band has two thick crests. It forms a dorsal 'U' entirely occupied by the large protruding dorsal tubercle, the opening of which forms two opposing spirals (Fig. 50C). The dorsal lamina is long and rises in height near the oesophagus entrance. It is not linked to any branchial fold. Its rim has small lobes. The sides of the endostyle are covered with small papillae.

The branchial sac has a different number of folds on each side. Thus, there may be eight complete and two incomplete folds on the right side, and six complete and two incomplete folds on the left side. There are generally 15–20 vessels on the complete folds and a single vessel between the folds. The vessel between the folds belongs to the dorsal part of the next fold. The number of stigmata varies in different parts of the branchial sac. Generally there are parastigmatic vessels. The transverse vessels do not bear papillae.

The stomach is covered by a large hepatic gland divided into several uniform lobes (Fig. 50C). The lobes consist of parallel lamellae, the rims of which are covered with small papillae. The rear intestine curves to join the middle part of the intestine forming a secondary loop (Fig. 50D) far less accentuated than in *Microcosmus exasperatus*. The rectum is attached to the body wall and the branchial tissue. The anus has a smooth edge.

There is a gonad on each side more or less distinctly divided into three lobes (Fig. 50C). The right gonad is located far to the anterior, leaving a large empty area behind it (Fig. 50C). The ovary is central and the testes are placed around it. The gonoducts are very short and sometimes hidden under the testis mass.

In this species the endocarps are very reduced, surrounding the gonads and the posterior intestine in a kind of envelope. There are no independent endocarps. Both siphons have large velums. A ring of tentacles lies at the base of the cloacal siphon.

Remarks and distribution

This species has been confused with *M. exasperatus*. It differs from it in spinule shape (Fig. 50C, D) and the secondary bend of the gut. It is possible that the specimen named *M. exasperatus* by Millar belongs to this species; the description could correspond to either species.

The synonymy given by Kott (1985) is probably incomplete, as some descriptions of *M. exasperatus* not cited by Kott mention a gut without a pronounced secondary loop.

Microcosmus squamiger is a species of Australian origin, where it is encountered in natural habitats. It colonizes harbours and was recorded in the Mediterranean Sea from Italy and Tunisia in 1981. Lambert & Lambert (1998) reported its arrival in California. Since then it has become cosmopolitan. The South African populations were probably also imported.

Pyura capensis Hartmeyer, 1911

Fig. 52

Pyura capensis Hartmeyer, 1911: 561, pl. 47 (fig. 10), pl. 57 (fig. 8). Millar, 1962: 195, fig. 37.

Material

One specimen. False Bay (Griffiths coll.).

Description

The specimen was attached by the posterior part of the left side. The body (50 × 30 mm) is cylindrical. The siphons are terminal and protruding, 10 mm apart, with four lobes. The tunic is hard and covered with tubercles. The whole tunic is covered with brown, sclerified plates on a paler ground. We have not seen siphonal spines either in light microscopy or scanning electron microscopy. In formalin the colour turns ochre with a thin pink ring around the siphons.

The musculature is strong, continuous on the whole opaque body except below the gut. There are about 20 large oral tentacles and 10 smaller ones, irregularly distributed. All of them bear three orders of branchings, regularly arranged. The prepharyngeal band lies between two equal crests, draws a dorsal 'V', and is prolonged under the dorsal tubercle by a small groove. The dorsal

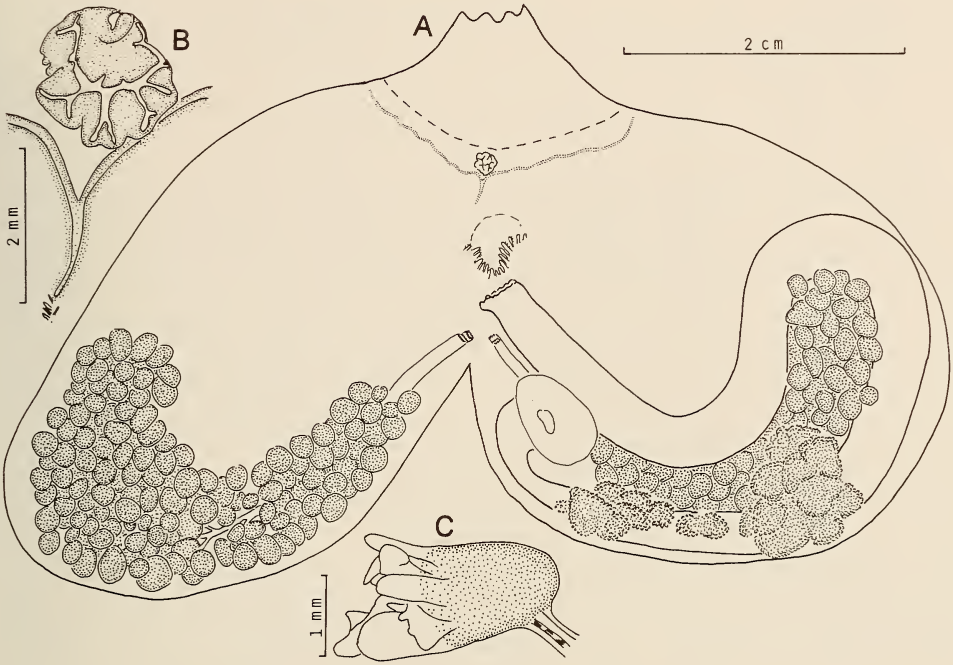

Fig. 52. *Pyura capensis*. A. Specimen opened along the ventral line, endocarps not figured. B. Dorsal tubercle. C. Pedunculate gonad lobe covered by endocarps.

tubercle is protruding with a characteristic shape (Fig. 52B) and a ramified aperture, already mentioned by previous authors.

The dorsal tubercle is hidden under the oral tentacles. The dorsal lamina forms short pointed languets on an unperforated band where the transverse vessels disappear. Consequently the dorsal languets do not correspond to the vessels and may be displaced on the right and chiefly on the left side. The dorsal lamina finishes at the anterior part of the protruding roll encircling the oesophagus entrance.

Seven branchial folds recover each other on each side. We counted on the right side:
R.E. 1 (8) 3 (12) 5 (16) 4 (17) 5 (19) 3 (16) 3 (15) 3 D.L.

The seven folds extend the whole length of the branchial sac. They converge and are abruptly cut at the oesophagus entrance, the longitudinal vessels ending in a sharp papilla. In addition, in the very posterior part, there is one fold on the right side and two on the left side. They are formed by 2–5 vessels and do not reach the oesophagus. The first vessel on the right of the dorsal lamina parts from it posteriorly. The space left is irregularly perforated.

The branchial vessels are high. The branchial meshes are transversely lengthened. We counted 8–12 oval stigmata in a mesh between the folds and 5–8 on the folds. At the top of the folds, indications of the generative spirals persist. There are parastigmatic vessels in some places.

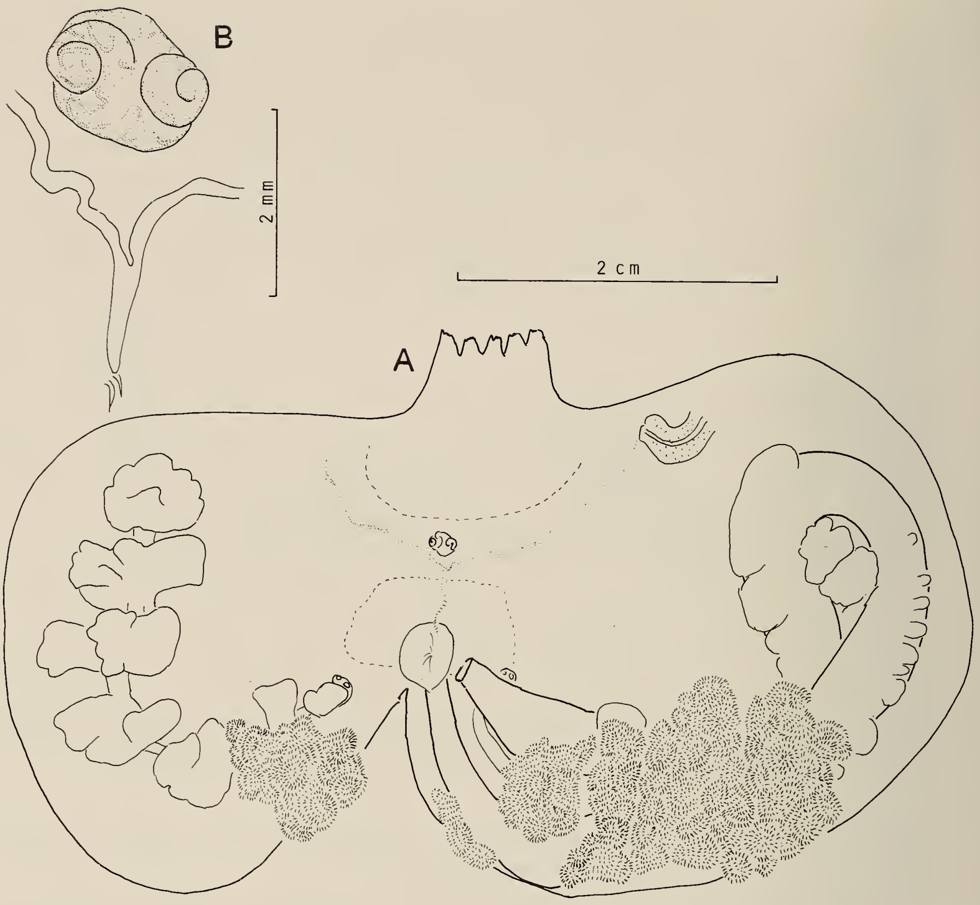

Fig. 53. *Pyura stolonifera*. A. Young specimen. B. Dorsal tubercle of the same.

The gut forms a closed loop in the posterior part of the body (Fig. 52A). A curved oesophagus enters a slightly enlarged stomach. The hepatic gland forms three swollen lobes (Fig. 52A). The long rectum ends in an anus with two scalloped lobes.

The gonads are also located in the posterior part of the body (Fig. 52A). The gonadal ducts constitute an axis with few ramifications, and around these branches are clusters of hermaphroditic lobules, often without any contact with the body wall. The genital ducts end in two wide papillae with dented rims, opening a short distance behind the anus (Fig. 52A). Each gonad lobule is covered on its cloacal side by about ten endocarps (Fig. 52C). The remainder of the body wall and the gut is covered with long, tight endocarps, more than a hundred per square centimetre. It was impossible to draw them. The cloacal siphon is internally encircled, mostly in the posterior part, by a line of elongated papillae, resembling endocarps but longer and with small ramifications that correspond to cloacal tentacles (Fig. 52A).

Distribution

Pyura capensis is geographically limited to the Western Cape Province.

Species of the *Pyura stolonifera*-group

Amongst material attributed to *Pyura stolonifera* several distinct species were described, two from South Africa and one from Australia. The Australian species has also been recorded on the Pacific coast of South America and along the west coast of Africa from Dakar to the Gibraltar Strait. Specimens from these locations were compared with South African samples and studied by Monniot & Bitar (1983). The most important difference concerns the arrangment of the right gonad lobes: in one line in *P. stolonifera* and in two lines in the Australian specimens. We now identify the Australian population as *Pyura praeputialis* (Heller, 1878) *sensu lato*. In that species, Kott (1985) pointed out differences, also noted by Dalby (1994) in his Ph.D. dissertation. In subsequent publications Dalby (1995, 1996) stated that both morphologies found in the Australian population are genetically controlled, and consequently represent two species, but no taxonomic decision has been published.

In South Africa, a similar case occurs as two forms can be recognized in the field. The internal differences are less obvious but nevertheless exist. They already appear in young specimens and they are described here from these specimens. They correspond to the two species *Pyura stolonifera* (Heller, 1878) and *Pyura herdmani* (Drasche, 1884). Both species may reach more than 10 cm in length when adult. The large specimens have a complex morphology difficult to interpret, so the drawings were made from small juvenile specimens, where the characteristics already appear.

Pyura lignosa Michaelsen, 1908 *sensu stricto* (Monniot, C. 1994), from the west coast of Panama is allied to this species group.

Pyura stolonifera (Heller, 1878)

Figs 51F, 53

Cynthia stolonifera Heller, 1878: 92, pl. 2 (fig. 10).
Microcosmus coalitus Sluiter, 1898*a*: 57, pl. 2 (fig. 8), pl. 7 (figs 9–10).
Halocynthia vanhoffeni Michaelsen, 1904: 197, pl. 10 (fig. 13), pl. 12 (fig. 44).
Cynthiopsis coalitus: Michaelsen, 1904: 210.
Pyura (Halocynthia) stolonifera: Hartmeyer, 1912: 246 (*part.*).
Pyura stolonifera: Millar, 1962: 193, fig. 36C (*part.*).

Material

Several specimens. False Bay, 0–2 m (Griffiths and Monniot coll.).

Description

From very shallow water, this species forms soft spheres, generally covered with epibionts. Both its siphons are large, close together, and most often with tubercles. The siphonal spines are 25–30 μm long (Fig. 51F), and are stout and originate from a slightly protruding base. They are cone-like with a blunt tip.

Out of the tunic the lobes of the siphons are toothed. The large tentacles are very ramified to make an efficient filter at the branchial sac entrance. The dorsal tubercle protrudes in two spiral cones. Its opening follows a curved line, even in small specimens; the opening has characteristic undulations (Fig. 53B). The dorsal lamina is very short, made of languets and connected to a wide circular area encircling the oesophagus entrance. The endostyle is very long, more than ten times that of the dorsal lamina.

The branchial sac has six folds in arcs. All the folds end at the oesophagus entrance by a series of papillae that correspond to the longitudinal vessels.

As the siphons are close together, the oesophagus is long. The stomach is not dilated and is covered by a voluminous hepatic gland with lobes in the shape of cauliflower (Fig. 53A). The anterior lobe (figured here cut in two parts) overflows on to the right of the body side. The intestine describes a marked loop, but its way is hidden by endocarps. The rectum is short. The anus has a smooth or slightly lobed rim.

There is one gonad on each side made of few lobes in only one line (Fig. 53A). These lobes are covered with large irregular endocarps. The gonadal ducts open near the cloacal siphon in a papilla uniting the oviduct and sperm duct. The figured specimen (Fig. 53A) is not adult and the endocarps covering the lobes may give the appearance of two rows of lobes. In large adult specimens the gonad lobes appear clearly in one row visible as such from the external side of the body once it has been removed from the tunic.

Distribution

This species occurs from Namibia, along the west coast of South Africa, and extends eastwards as far as Durban.

Pyura herdmani (Drasche, 1884)

Figs 54, 55A, B

Microcosmus herdmani Drasche, 1884: 370, pl. 2 (figs 3–7).
Cynthiopsis herdmani: Michaelsen, 1904*a*: 208, pl. 12 (figs 41–43).
Cynthiopsis valdiviae Michaelsen, 1904*a*: 201, pl. 12 (figs 35–40).
Pyura (Halocynthia) stolonifera: Hartmeyer, 1912: 246 (*part.*).
?*Pyura stolonifera*: Millar, 1955: 210, fig. 34.
Pyura stolonifera: Millar, 1962: 193, fig. 36D (*part.*).

Material

Several specimens. Miller's Point, False Bay, 2 m; Namibia, Langstrand, Swakopmund (Griffiths coll.)

Description

Pyura herdmani differs from *P. stolonifera* in its external appearance. Young specimens are orange in colour and have large pointed papillae of hard and naked tunic that make a collar around the siphons. When the animals grow, the tunic increases in thickness, becomes stiffer and includes sediment. The papillae around the siphons are less and less visible. The tunic is totally covered

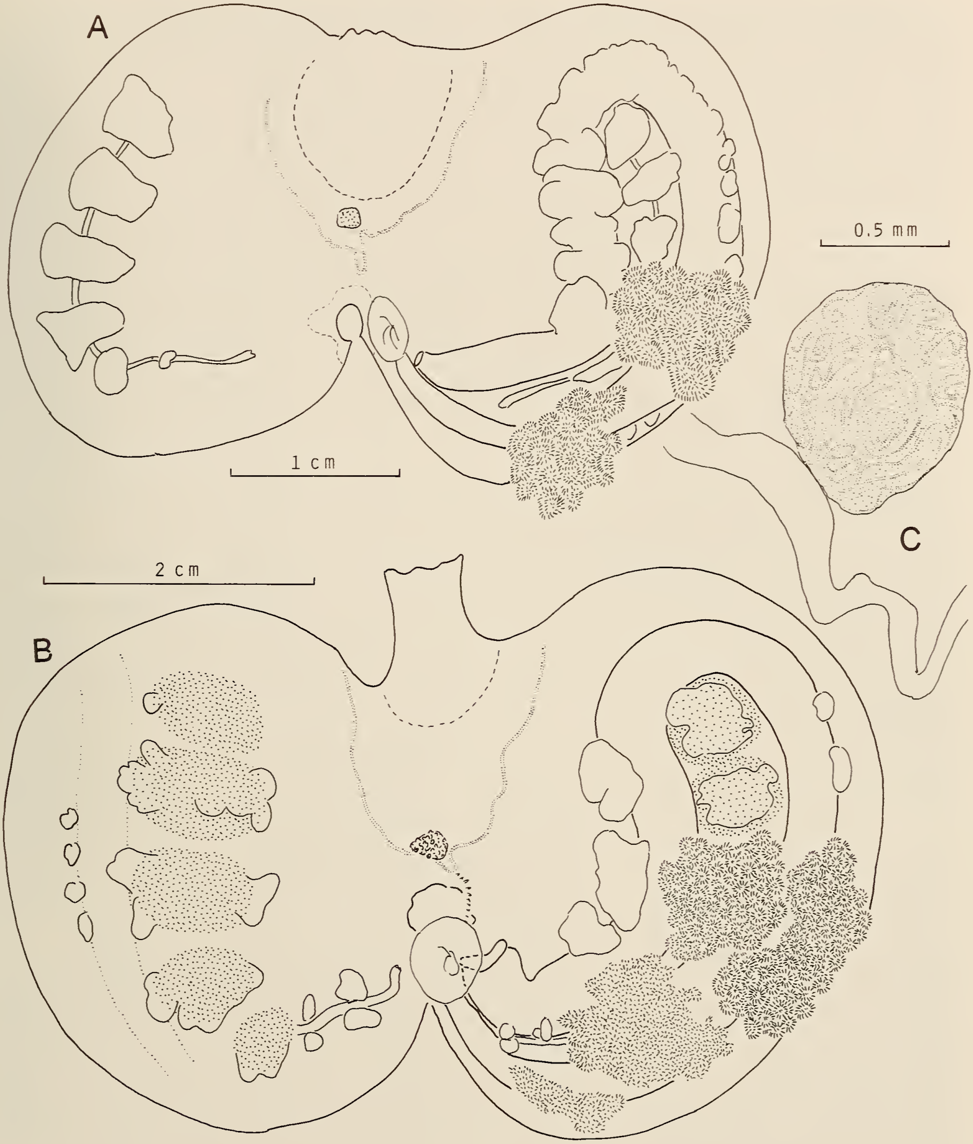

Fig. 54. *Pyura herdmani*. A–B. Two young specimens. C. Dorsal tubercle of a small specimen.

with epibionts and the toothed rims of the siphons disappear. The rare siphonal spines (Fig. 55A, B) only occur in places, separated by large irregular areas (Fig. 55A). They are stout, in shorter cones than in *Pyura stolonifera*, appearing in buttons. In other places on the internal side of the siphon the tunic is densely covered with digitiform papillae in the fashion of a velvet cloth (Fig. 55B). The role and nature of this structure remains unknown.

The oral tentacles are identical to those of *P. stolonifera*. The dorsal tubercle is very different, sponge-like in adult and even in young specimens. In very young specimens of only 20 mm, smaller than those shown in Figure 54A, B, a structure suggesting two spirals remains visible (Fig. 54C), but the opening is already cut in pieces and becomes irregular. Supplementary coils and supplementary independent perforations exist. In older but not yet adult specimens as figured (Fig. 54A), the dorsal tubercle has a spongy appearance.

The dorsal lamina and the branchial sac are similar in *P. stolonifera* and *P. herdmani*. In adult specimens the endocarps cover the whole surface of the digestive tract and of the gonads (Fig. 54A, B).

The distribution of this species extends from Namibia to KwaZulu-Natal.

Halocynthia spinosa Sluiter, 1905

Figs 55C–F, 56

Halocynthia spinosa Sluiter, 1905: 16, pl. 2 (fig. 8).
Halocynthia spinosa defectiva Millar, 1962: 201.
Halocynthia defectiva: Millar, 1964: 178, fig. 14.
Halocynthia spinosa Monniot, C., 1973: 60, fig. 4c.

Material

Several specimens. False Bay, 6 m (Griffiths coll.); Ibo Island, Mozambique (Monniot coll.)

Description

The largest specimen is 50 mm long. It was attached by the posterior part of the ventral side. Both siphons are long (10 and 15 mm) and close. In life the colour is pink, paler and yellowish on the siphons. The tunic is tough but flexible, entirely covered with small tubercles with a central spine or a branched spine circled by 4–6 smaller ones (Fig. 55D). Near the siphons the tubercles are more protruding, with lateral spines almost as long as the central one (Fig. 55C). Inside the siphons, in the deeper part, the siphonal spines are made of a central sharp point flanked by very small spines (Fig. 55F). More distally, the short spines surrounding the central one lengthen and reach a large size (Fig. 55E). The final structure results in a body that resembles a spiny ball with a crown of long points at the top. The spines on the siphons are not longer than those on the sides of the body.

The body wall is made opaque by a well-developed musculature. Twenty-five oral tentacles in 3–4 orders of size are laterally flattened and anteriorly curved, like sickle blades. The posterior sides of the tentacles bears two rows of

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Fig. 55 *(see facing page)*. A–B. *Pyura herdmani*. A. Siphonal spines. Scale bar = 20 μm. B. Internal siphonal papillae. Scale bar = 10 μm. C–F. *Halocynthia defectiva*. C. Spines of the siphonal rim. Scale bar = 200 μm. D. Spines of the external side of the siphons. Scale bar = 200 μm. E. Spines of the internal distal part of the siphons. Scale bar = 100 μm. F. Spines of the deep internal part of the siphons. Scale bar = 100 μm.

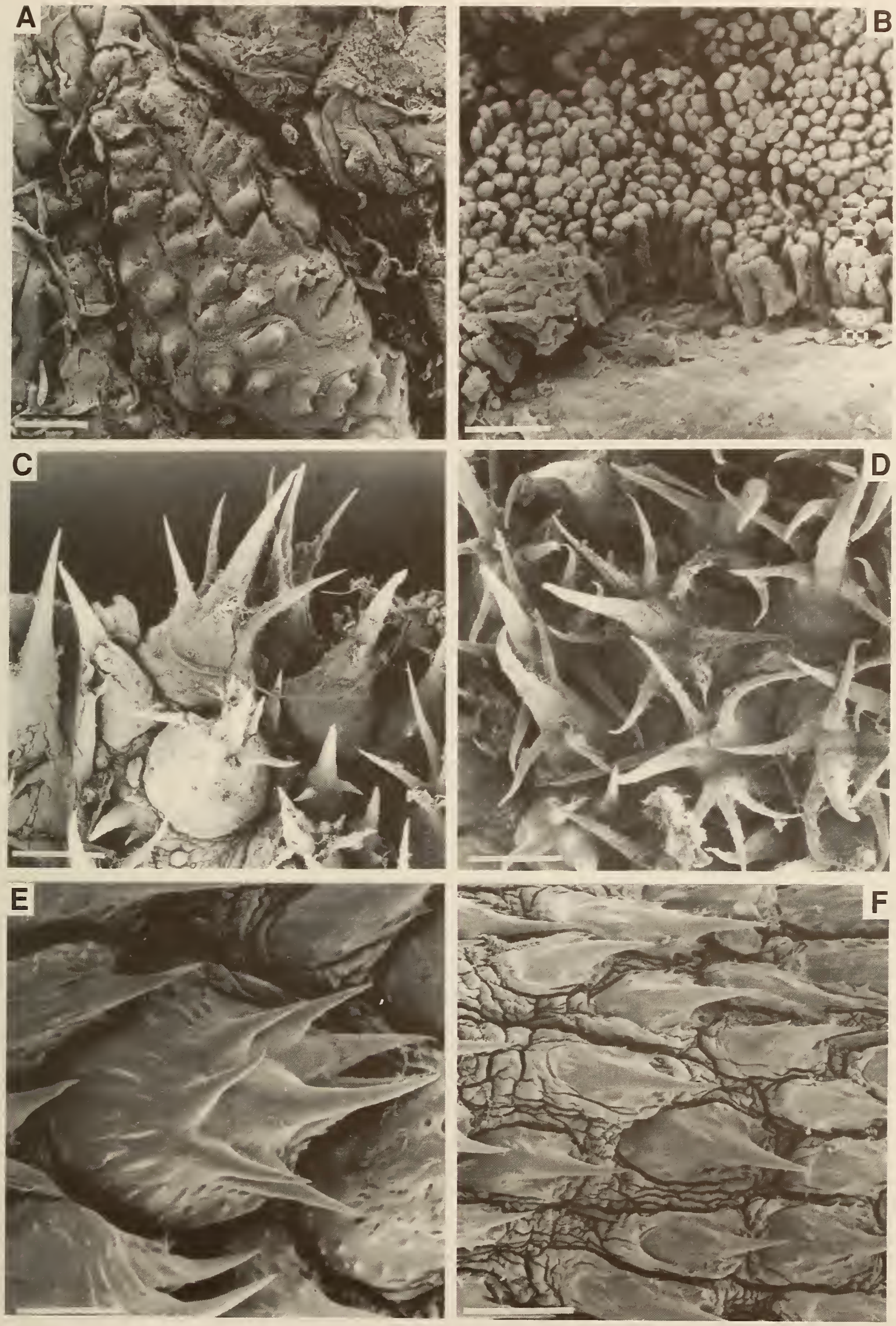

Fig. 55

digitiform branches themselves divided two times again. The branches are perpendicular to the primary tentacle. The prepharyngeal band has two equal crests. It makes undulations around the branchial folds and traces a dorsal 'V' (Fig. 56A). The dorsal tubercle is very protruding with two curled horns (Fig. 56B). The dorsal lamina is made of long languets corresponding to the right transverse vessels. The transverse vessels on the left also end in smaller papillae, and this gives the aspect of a doubled dorsal lamina. The dorsal lamina is interrupted before the oesophagus entrance.

The branchial sac is made of ten complete folds on each side, to which are added one ventral fold on the left and two on the right in the very anterior part. The folds are high, recovering each other. We counted 20–30 vessels on a fold and 2–4 between the folds. The meshes are tranversally elongated each with 10–14 stigmata between the folds and 4–6 on the folds. The stigmata are rather short, often cut by parastigmatic vessels. At the oesophagus entrance, the folds are suddenly interrupted and the longitudinal vessels end in papillae.

The gut forms a wide loop (Fig. 56A). The long oesophagus enters a wide stomach. The anterior part of the hepatic gland shows internal ridges in its longitudinal axis; the posterior part is raised in many papillae (Fig. 56A, C). The rectum is not attached to the body wall; it ends in a widely opened anus. The two gonads are located on the intestine. The most anterior one lies entirely over the intestine, the posterior one crosses the intestine and extends into the space between the two limbs of the gut (Fig. 56D). The ovary is central, not protruding. The testis lobes extend on each side of the ovary in a thin layer covering the whole free intestinal surface (Fig. 56A). The gonads open by two papillae on the intestine. The disposition of the gonads is totally masked in aged specimens and can only be deciphered in young individuals (Fig. 56D).

The right side of the body is covered with endocarps (Fig. 56A). Some of them also lie inside the gut loop, but none above the intestine.

Both siphons have a short velum, the cloacal one with round lobes at the base.

Remarks and distribution

Halocynthia defectiva is closely allied to *H. spinosa* Sluiter, 1905. Both species have in common the presence of only two gonads, located on the left side, above the intestinal loop. *Halocynthia spinosa,* living in the Red Sea, has large siphons with, on their edge, 2-mm long ramified spines, slightly ramified tentacles, a low dorsal tubercle, 7–9 complete branchial folds and only one supplementary fold on the right side, and both gonads located over the descending limb of the intestine.

The sample from Bahrain described by Millar (1975) under the name *Halocynthia arabica defectiva* corresponds, in our opinion, to a true *H. spinosa* with large ramified spines, poorly ramified tentacles and gonads crossing the intestine.

Halocynthia spinosa has been recorded from the Red Sea and Arabian Gulf and its distribution extends to False Bay, South Africa.

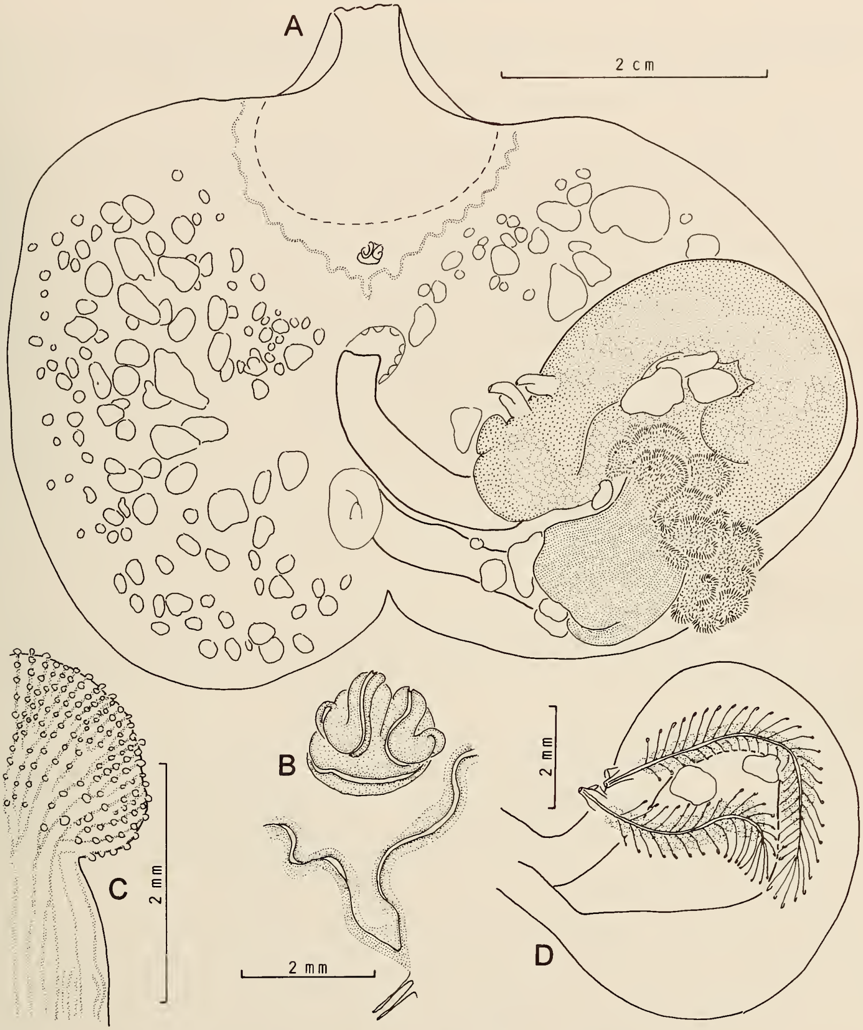

Fig. 56. *Halocynthia defectiva*. A. Large specimen. B. Dorsal tubercle. C. Detail of the hepatic gland of a young specimen. D. Gonads of a young specimen.

Family **Molgulidae**

Molgula conchata Sluiter, 1898*a*

Fig. 57

Molgula conchata, Sluiter, 1898*a*: 58, pl. 7 (figs 11,14). Millar, 1955: 214, fig. 38; 1962: 203, fig. 43.
Ctenicella conchata: Hartmeyer, 1914: 14, fig. 6.
Ctenicella natalensis Michaelsen, 1918: 2, figs 9–11.
Molgula natalensis Vasseur, 1967: 121, pl. 7 (figs 63–68).
non *Molgula conchata*: Monniot, C., 1969: 651, fig. 111.

Material

Several specimens. Port Elizabeth, intertidal; Knysna (Monniot coll.).

Description

This *Molgula* species has a large size, up to 40 mm. It was found on rocks in the littoral zone. The tunic is embedded with sediment throughout its thickness. The body is often covered with epibionts, mostly with hair-like bryozoans. The siphons are close together, in hollows and encircled by a ring of hard and thick tunic. A thickening of the body wall corresponds to this ring of tunic. The siphonal lobes are deeply cut. The musculature is only developed on the dorsal side of the body. It is made of short ribbons around each siphon and in the area between the siphons. The muscle arrangment exactly follows the pattern of the hollows of the tunic. The remainder of the thin body wall is devoid of muscular bundles. The oral tentacles are not numerous, only 16, in two orders of size, and some very small ones. The tentacles are thick with numerous regular branches in four orders. The tentacular ring closes the siphon aperture. The prepharyngeal band draws marked curves at the level of the branchial folds and has a deep dorsal 'V'. It is made of two irregular rims, the posterior higher.

The dorsal tubercle is protruding, its opening in the shape of a transverse 'S' (Fig. 57C). The dorsal lamina is short as the siphons are closely placed.

The branchial sac has seven folds on each side. On the right side we counted:
R.E. 0 (8) 0 (9) 0 (10) 0 (11) 0 (11) 0 (11) 0 (11) 0 D.L.

The folds are very asymmetrical and the most dorsal vessels, in variable number, are very thin. The longitudinal vessels of the folds fuse into a continuous band at the oesophagus entrance. The branchial sac has a uniform structure in all parts with longitudinal stigmata between the folds and infundibula under the folds.

The gut follows a double closed loop (Fig. 57B, C). The oesophagus is short, largely covered by the hepatic gland. There is no stomach dilatation. The anus, with a smooth rim, is attached to the side of the oesophagus entrance.

The gonads are made of a massive and protruding ovary, partly covered by the testis. The latter forms a crown around the blind extremity of the ovary. The oviduct and sperm duct are independent. The arc-shaped kidney is full of concretions. The cloacal siphon has a wide muscular velum, as does the oral siphon.

Remarks and distribution

Millar (1962: 204, figs 42, 43c) described *Molgula cryptica* from False Bay, a species very closely allied to *M. conchata*. Both species have the same kind of gonads, gut and siphons. These species differ by the tissues consistency, the length of the siphons, and the number of branchial vessels. The intestine of *M. cryptica* draws a less-closed loop and the gonad is applied on the bottom of the loop. In addition, *Molgula cryptica* is a brooding species. Millar (1962) has compared his species to the Antarctic *M. pulchra*. Monniot, C. (1969) described a population of *M. conchata* from Dakar. This synonymy is erroneous. The specimens from Dakar have the same gut shape but the ducts of the gonad are different.

Molgula conchata is recorded from Mauritius and South Africa.

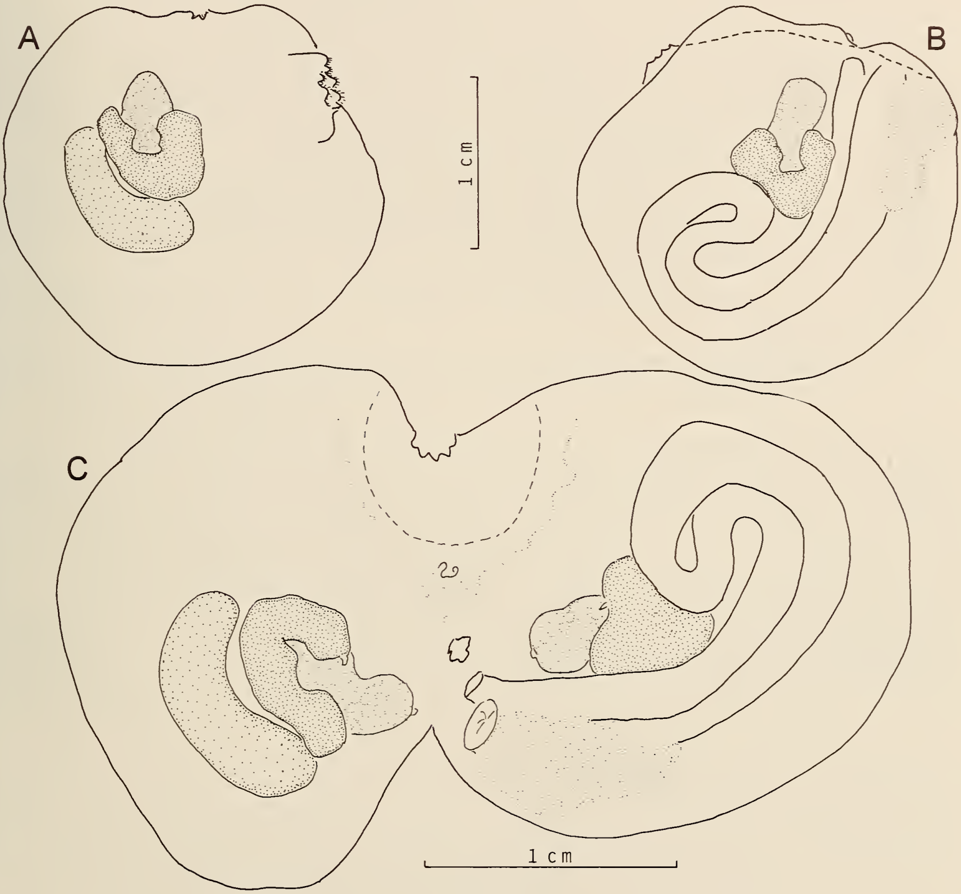

Fig. 57. *Molgula conchata*. A–B. Right and left sides of a specimen. C. Specimen opened along the ventral line.

Molgula falsensis Millar, 1955
Figs 58, 59

Molgula falsensis Millar, 1955: 217, fig. 40; 1960: 129, fig. 55; 1962: 203, fig. 43A; 1964: 179.

Material

One large specimen: Miller's Point, False Bay, 6 m (Griffiths coll.). Several small specimens: Saldanha Bay Harbour and Port Elizabeth Harbour (Monniot coll.).

Description

Brooding specimens with a soft tunic

The population is made of agglomerated spheres. The tunic is covered with short rhizoids that accumulate sediment particles and debris. The tunic is thin and soft. The slightly protruding siphons have sharp lobes on their rims. The muscles form about 30 short and thick bundles on each siphon; they are absent in the middle of the dorsal side between the siphons. Some short muscles lie along the ventral side. About 30 oral tentacles are distributed in three orders. They are long with three sets of finger-like ramifications.

The prepharyngeal band has two thick rims; it draws a low dorsal 'U'. The dorsal tubercle is large and protruding. Its opening is a 'U' with sides slightly inwardly curled. The dorsal lamina is short. The branchial wall has seven folds on each side; the branchial formula is:

R.E. 0 (2) 0 (4) 0 (5) 0 (6) 0 (5) 0 (5) 0 (3) 0 D.L. 0 (3) 0 (5) 0 (5) 0 (6) 0 (6) 0 (4) 0 (3) 0 E.L.

The longitudinal vessels are high and thin. On the ventral side of the folds they can recover each other. The six primary infundibula are cut up into

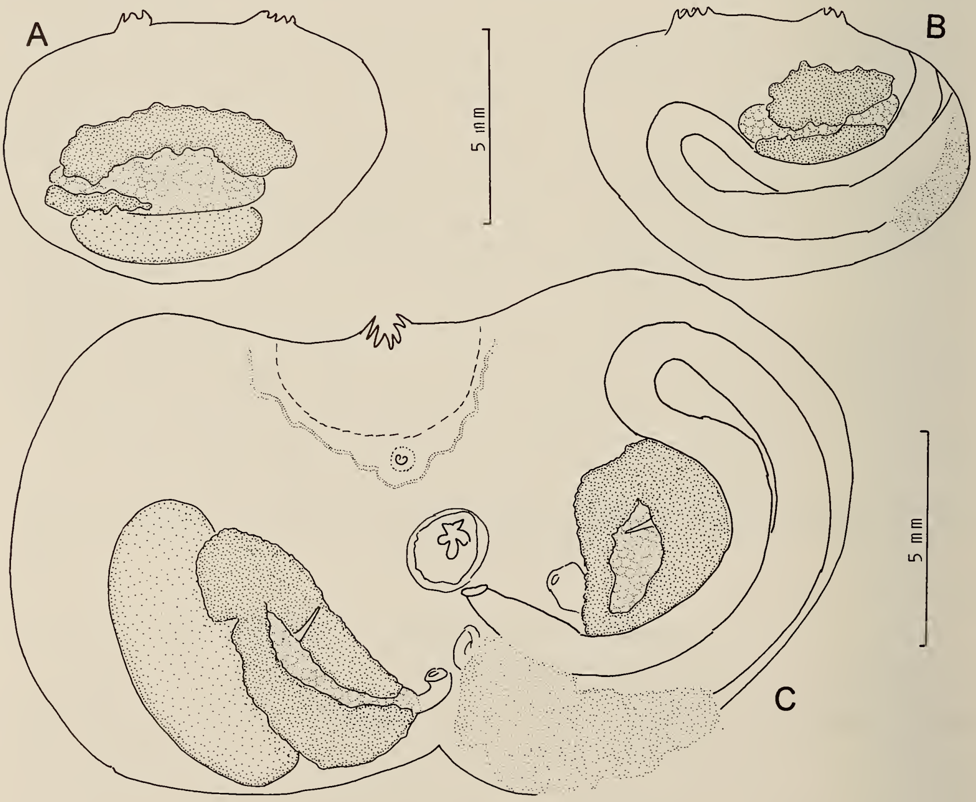

Fig. 58. *Molgula falsensis*. Brooding specimen. A–B. Right and left sides. C. Internal structure.

3–4 secondary infundibula along the fold axis. At this level, the branchial perforations are irregular with numerous exoinfundibula. Between the folds, the stigmata are longitudinal. They are short, cut in pieces, and sometimes make exoinfundibula. At the level of the oesophagus entrance the longitudinal vessels fuse to constitute a continuous membrane.

The gut (Fig. 58B, C) has a slightly curved secondary loop. The hepatic gland covers the whole anterior part of the gut. It is massive, made of irregularly distributed lamellae. The rectum is short with a smooth rim around the anus. The kidney is widely spread but only slightly protruding.

The gonads (Fig. 58A, B, C) have a central ovary circled by a ring of testis lobes that partially cover the ovary. The arrangement of the testis lobes on the ovary varies among the individuals. There is a single sperm duct in the middle of the gonad. The oviduct opens through a large papilla close to the cloacal siphon.

All the collected specimens contained a large number of segmented eggs, reaching the morula stage.

Specimen with hard tunic

The body forms a slightly flattened ball 30 × 25 × 21 mm. The oral siphon is terminal, the cloacal siphon is 13 mm away. The conical siphons have six and four sharp lobes at their top. The tunic is 1 mm in thickness, stiff and whitish. The anterior part of the body is naked or with few epibionts, the posterior part bears finger-like rhizoids accumulating debris and sediment.

The body wall is fleshy but translucent. The muscles are made of about 30 bundles radiating from each siphon, except between the siphons where they are absent. The muscular bundles are short and on both sides are interrupted before the level of the gonads and gut. The most dorsal muscles of each side join but do not fuse.

There are 12 oral tentacles arising from a protruding ring. They have large first-order ramifications covered with numerous ramifications of second and third orders. The prepharyngeal band is thick, undulated at the level of the branchial folds (Fig. 59C). It draws a pronounced dorsal 'V'. The dorsal tubercle protrudes with the two horns of the right-hand opening slightly curled.

The branchial sac has seven folds. The right-side formula is:
R.E. 0 (12) 1 (12) 1 (14) 1 (16) 1 (16) 1 (16) 1 (13) 1 D.L.

The vessel located between the folds represents the most dorsal vessel of the next fold. The vessels are thicker on the ventral side than on the dorsal side of the folds. At the level of the oesophagus entrance, the folds are interrupted, the vessels fuse to make a kind of protruding wide-mouthed funnel to the oesophagus. The six primary infundibula are cut out into 4–6 secondary bispiral infundibula. Between the folds, over the primary infundibula the longitudinal vessels are cut in short pieces. There are no exoinfundibula between the folds.

The intestine draws a slight secondary loop (Fig. 59B, C). After a very short oesophagus, the stomach is covered with a large hepatic gland made of irregular lamellae. The intestine is covered with a diffuse part of the hepatic gland that hides its shape. The rectum is short, the anus has a plain rim.

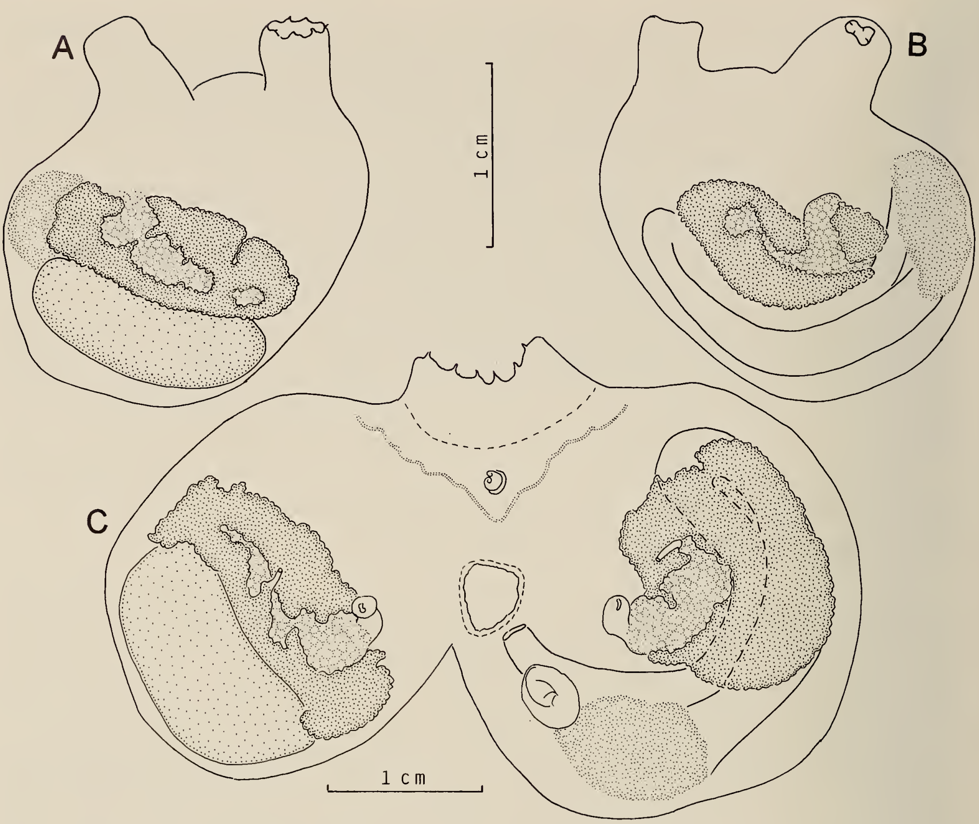

Fig. 59. *Molgula falsensis*. Specimen with a hard tunic. A–B. Right and left sides. C. Internal structure.

The gonads lack a definite outline (Fig. 59A, C). They are made of the central ovary covered by a mass of testis lobes. On the right side the testis lobes partly encircle the kidney. On the left side they spread on a large part of the gut (Fig. 55C). Each testis opens by a single papilla in the middle of the gonad. The female papilla is round and protruding. No segmented eggs were present in the cloacal cavity of this specimen.

The kidney is voluminous. The cloacal siphon is encircled by a short velum.

Remarks and distribution

Between 1955 and 1964, Millar described three forms of *Molgula falsensis*. In all three cases, the species are small, 15 mm maximum, with a thin tunic covered with hair. None of his descriptions mentions brooding.

In our collection we have identified two forms. One of them has a large size (30 mm), with a largely tunic, smooth, thick and rigid. The other is smaller (15 mm) with a soft tunic covered with hairs and sediment, and it is brooding. The large specimen was collected at False Bay in a natural site, the small specimens in harbours at Saldanha Bay and Port Elizabeth. Both forms are closely allied and only differ by the larval brooding and the tunic structure. In the largest specimen the branchial structure is simpler than in smaller animals. A similar case occurs in Europe and distinguishes *Molgula occulta* from *Molgula oculata*.

Molgula falsensis is a South African species.

Molgula scutata Millar, 1955

Fig. 60

Molgula scutata Millar, 1955: 215, fig. 39; 1962: 202, fig. 34B. Monniot, C. & Monniot, F., 1976*b*: 672. Turon, 1988: 282, fig. 8.

Material

Large-size specimens. Sea Point, intertidal (Monniot coll.); Namibia (Gibbons coll.).

Small-size specimens (less than 10 mm). Isipingo, intertidal (Griffiths coll.); False Bay, Gerikespunt, Knysna, 1–2 m (Monniot coll.).

Description

This species was encountered in two different forms, one of a large size (20–40 mm), the other smaller (5–15 mm) and brooding.

Large form

The specimens from 20–40 mm are weakly attached to rocks. Their tunic, rather stiff, is covered with sediment, mostly in the siphonal area. The sediment particles adhere to the body surface, but are not included into the tunic as in *Molgula conchata*. Even in contracted animals, the siphons, close to each other, remain protruding. Their rim is not dentate, but slightly irregular.

The body wall has some strong muscles on the siphons (Fig. 60A, B). They are interrupted on the side of the body. These bundles are more or less elongated in varied samples, or they may be very short constituting a ring around the siphons. There are also some areas with transverse muscles (Fig. 60A, B). About 12 large oral tentacles in 2–3 orders have elongated branches of at least three orders. Some very small tentacles are irregularly intercalated. The prepharyngeal band has two unequal rims, the anterior more developed. The dorsal indentation is not well marked. The dorsal tubercle is protruding, of variable shape from a simple slit (Fig. 60C) to a double spiral. The dorsal lamina is short.

The branchial sac has a characteristic structure. The folds carry two vessels, both of them lying on the ventral side on the fold. The longitudinal vessels are wide and high as those observed in the Molgulidae, which have only one vessel per fold. The stigmata are short, most of them longitudinal. The digestive tract (Fig. 60B, C) describes a deep secondary curve. The stomach is not enlarged. The hepatic gland is voluminous. The intestine has a uniform diameter with a short rectum ending in a smooth-rimmed anus.

On the left side the gonad (Fig. 60C) occupies the whole space between the two curves of the gut. The ovary, obscure in outline is partly covered by

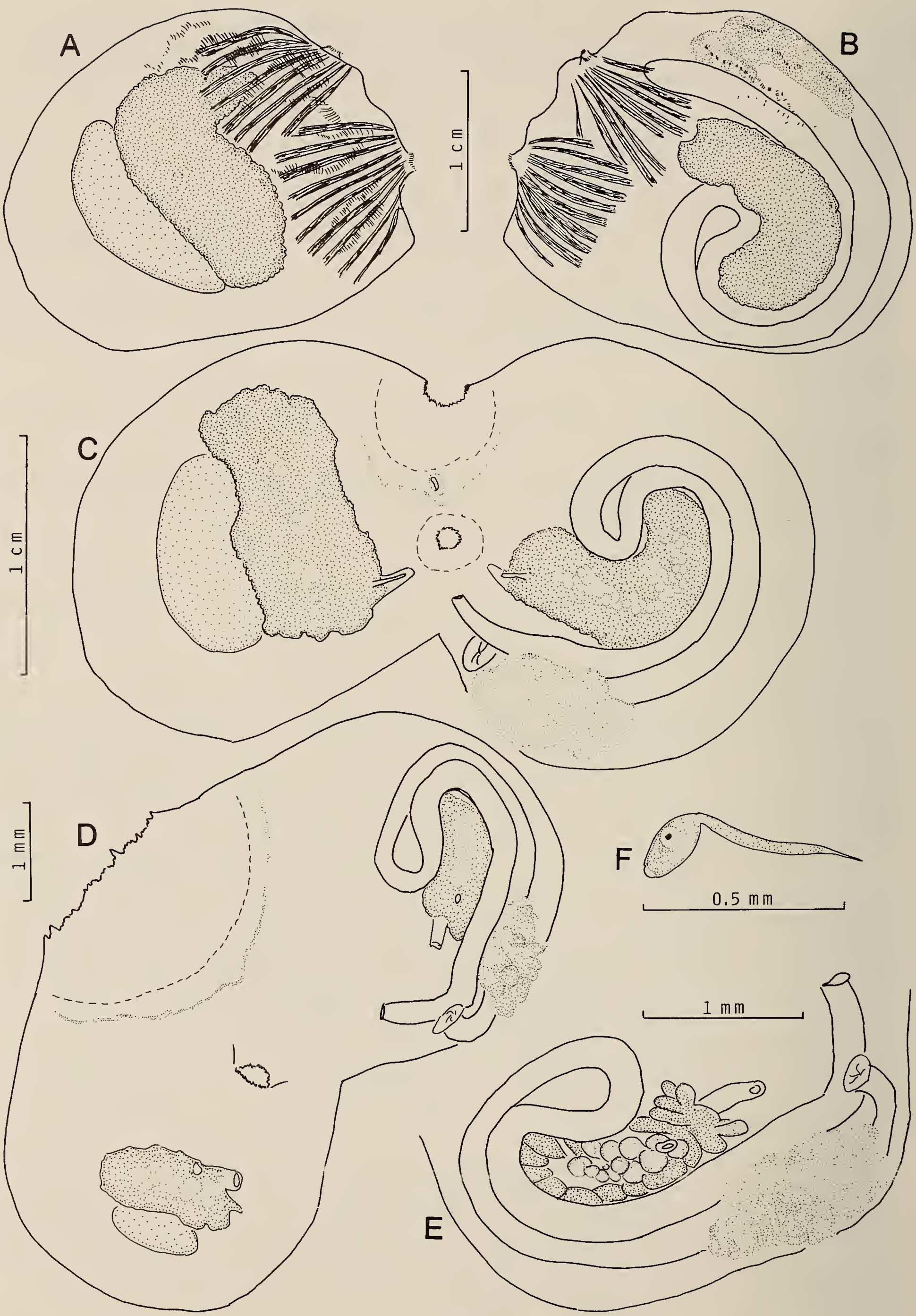

Fig. 60. *Molgula scutata*. Large specimen. A–B. Right and left sides. C. Internal structure, brooding specimen. D. Internal structure. E. Detail of the gonad and gut. F. Larva.

numerous and very small testis lobes. The gonads do not protrude into the cloacal cavity. Each opens by elongated sperm duct and oviduct, close to each other. The cloacal siphon has a muscular velum in a sphincter.

The specimens collected in deep waters off Namibia have a less strong musculature and a thinner branchial sac, a case often observed in deep habitats.

Small form

The small specimens (Fig. 60D) have the same kind of musculature as the large ones, but the bundles are thinner and never joined. The 12 tentacles are short with only ramifications of the first and second order. The dorsal tubercle has a single curve slightly concave to the right side. The branchial sac is even with curved stigmata and infundibula under the folds. The shape of the gut is the same as in a large specimen.

The main differences between these two forms concern the gonads. The sperm duct opens by a very short papilla far from the oviduct (Fig. 60D, E). The oviduct is attached to the body wall and opens in a flat papilla instead of an erect extremity. The small specimens are brooding. The small larvae (Fig. 60F) have a trunk 170 μm long and a notochord 420 μm long inside the tail.

Millar (1962) indicated that one of his specimens was brooding without providing further details.

Remarks

In South Africa the genus *Molgula* is represented by six different forms, which can be grouped in pairs: *Molgula conchata* and *M. cryptica*; two forms of *M. falsensis*; and two forms of *M. scutata*.

Each pair possesses an incubatory form. We do not have a large enough sample to estimate the variability within the different species, and the morphological characters are insufficient to solve the problem. Further biological studies of the brooding conditions, and molecular systematics are required to resolve the taxonomy of these forms.

OTHERS ASCIDIANS RECORDED IN SOUTH AFRICA BUT NOT PRESENT IN THIS COLLECTION

Family **Polyclinidae**

Aplidium agulhaense (Hartmeyer, 1912). *Amaroucium agulhaense* Hartmeyer, 1912 (p. 356, pl. 38 (fig. 4), pl. 44 (fig. 11)), from the Agulhas Bank (102 m depth) is pedunculate with only five rows of stigmata.

Aplidium claviforme (Hartmeyer, 1912). *Amaroucium claviforme* Hartmeyer, 1912: 348, pl. 39 (fig. 5), from Algoa Bay has club-shaped colonies, impregnated with sand, with very long zooids. It is insufficiently described.

Aplidium colelloides (Herdman, 1886). *Amaroucium colelloides* Herdman, 1886 (p. 233, pl. 27 (figs 9–12)), collected off the Cape of Good Hope at 250 m depth has stalked colonies with zooids in double rows in the head, having nine rows of stigmata and 12–13 stomach folds. Redescribed by Millar

(1962: 125, fig. 4) from the same location, it was also recorded in Namibia by Turon (1988: 276, fig. 2).

Aplidium exiguum (Herdman, 1886). *Psammaplidium exiguum* Herdman, 1886 (p. 245, pl. 31 (fig. 11)). This species was also collected at 170 m and at 318 m depth (Hartmeyer 1912: 338, pl. 39 (fig. 1), pl. 44 (fig. 7)) off the Cape of Good Hope. This species is lobed, embedded with sand. The zooids have 14 stigmata rows and 20 stomach folds, but are immature.

Aplidium galeritum (Hartmeyer, 1912). *Amaroucium galeritum* Hartmeyer, 1912 (p. 344, pl. 39 (fig. 4), pl. 44 (fig. 10)), from St Francis Bay, recorded again in False Bay (Millar 1962: 130; 1964: 172, fig. 10—Cape Province), has light grey pillar-like lobes, 9–12 stigmata rows and 12–14 stomach folds. The larvae are distinctive with a dense anterior fringe of small vesicles.

Aplidium lubricum (Sluiter, 1898*a*). *Amaroucium lubricum* Sluiter, 1898*a* (p. 31, pl. 1 (fig. 8), pl. 5 (fig. 1)). We have re-examined the type colony, ZMA TU 185 from Durban, which corresponds well to other records from Durban, Mozambique and Madagascar (Millar 1956: 915, fig. 2; Vasseur 1968; Monniot, C. & Monniot, F. 1976*a*: 362, fig. 1C–D). This species with nine stigmata rows, 15–20 stomach folds, long zooids and a larva with an anterior fringe of numerous vesicles, is restricted to the tropics.

Aplidium pantherium (Sluiter, 1898*a*). *Psammaplidium pantherinum* Sluiter, 1898*a* (p. 26, pl. 2 (fig. 3), pl. 4 (figs 8–9)). *Amaroucium unilarviferum* Millar, 1955 (p. 172, fig. 4; 1962: 123, fig. 3). Millar re-examined the type from Isipingo and a new collection from Cape Province, pointing out that the original description was erroneous. The zooids have only five stomach folds and a larva with an anterior fringe of round vesicles. The species was also recorded by Millar (1964: 172).

Aplidium retiforme (Herdman, 1886). The type specimen, *Psammaplidium retiforme* Herdman, 1886 (p. 248, pl. 32 (figs 8–10)), from Kerguelen, has been revised (Monniot, F. & Gaill 1978: 149, fig. 6C–F) with additional collections made in the same area. Millar (1962: 127, fig. 5) recorded this characteristic species from False Bay, with small slender lobes covered with sand.

Aplidium sarasinorum (Fielder, 1889). *Heterotrema sarasinorum* Fiedler, 1889 (p. 859, pl. 25 (figs 1–4)) from Ceylon was recorded again from False Bay and Mozambique (Millar 1962: 128, fig. 6). The zooids, with an average of ten stigmata rows and eight stomach folds, have a very short post-abdomen with a cluster of testis vesicles and a larva with a fringe of numerous anterior vesicles.

Aplidium schultzei Hartmeyer, 1913 (p. 141), from False Bay, was insufficiently described to be recognized.

Polyclinum constellatum Savigny, 1816 (p. 189, pl. 4 (fig. 2), pl. 18 (fig. 1)), is a widely distributed fouling species that was recorded by Millar (1955: 176, fig. 7) from Durban.

Polyclinum arenosum Sluiter, 1898*a* (p. 20, pl. 4 (fig. 12)), from Isipingo, was later recorded by Millar (1955: 174, fig. 5; 1962: 136, fig. 11) from Cape Province and Natal. It has a sandy colony divided in narrow lobes made of a single system each.

Polyclinum neptunium Hartmeyer, 1912 (p. 331, pl. 38 (fig. 9), pl. 44 (figs 2–4)), is very similar to *Polyclinum isipengense*, but the larva has different anterior ampullae. This species, described from the Cape of Good Hope in 106–318 m, was also recorded from equivalent depths in South Africa by Millar (1962: 136, fig. 11), 248–341 m depth. It is also present in Southern Australia (Kott 1963, 1972).

Synoicum australe Millar, 1962 (p. 133, fig. 8), from Mossel Bay (SAM–A25609), not recorded elsewhere.

Synoicum capense Millar, 1962 (p. 131, fig. 7), from False Bay (SAM–A25608), has not been recorded again.

Family **Polycitoridae**

Eudistoma mobiusi (Hartmeyer, 1905). *Colella mobiusi* Hartmeyer, 1905 (p. 396). *Polycitor mobiusi*: Hartmeyer, 1912 (p. 305), Cape Province and Madagascar. *Eudistoma mobiusi*: Millar, 1962 (p. 162), Cape Province. The species has a large larva 2-mm long but no other distinctive characters. It is also recorded from Mauritius and Mayotte (Comoros islands), but the identifications need to be revised.

Eudistoma renieri described as *Polycitor renieri* Hartmeyer, 1912 (p. 309), described from St Francis Bay, was recorded by Millar (1962: 160, fig. 23) from Durban. It has a twisted loop of the lower part of the rectum.

Eudistoma rhodopyge (Sluiter, 1898*a*). *Distoma rhodopyge* Sluiter, 1898*a* (p. 12, pl. 1 (fig. 2), pl. 3 (figs 5–6)); Michaelsen 1934 (p. 141, and synonymy). The colonies comprise several lobes arising from a common base. Without any distinctive character of the zooids, this species has been recorded from Cape Province to Durban, and from Madagascar, Mauritius and Mozambique.

Polycitor cuneatus Millar, 1964 (p. 160, fig. 1), has pedunculate colonies raised above ramified roots. It was only recorded once at 411–450 m depth, off Durban.

Polycitor nitidus (Sluiter, 1898*a*). *Distoma nitidum* Sluiter, 1898*a* (p. 17). This species from Durban is not sufficiently described and remains doubtful. It has not been recollected and Sluiter's descriptions are often erroneous.

Polycitor psammophorus Hartmeyer, 1912 (p. 300, pl. 38 (fig. 1), pl. 43 (figs 2–3)), off the Agulhas Bank, was described from immature colonies and was not recorded again. It has a doubtful generic position.

Cystodytes morifer Michaelsen, 1919 (p. 76, fig. 34), from Durban.

Cystodytes roseolus Hartmeyer, 1912 (p. 310, pl. 43 (figs 7–14)), Algoa Bay; Millar, 1962 (p. 141, fig. 13), Cape Province. The species, distributed from

Dakar to the Cape Province and the Seychelles, is characterized by the peculiar shape of the spicules.

Distaplia capensis Michaelsen, 1934 (p. 141), from the Cape Province, and found again by Millar (1962: 149, fig. 17; 1964: 168), has a folded stomach wall and gonads included in the gut loop. The colonies are purplish gelatinous lobes.

Distaplia durbanensis Millar, 1964 (p. 167, fig. 6), is only known from the type colony dredged at 411 m depth off Durban. The colony is stalked. The stomach wall has 40–50 narrow folds or lines of papillae.

Sigillina vasta Millar, 1962 (p. 153, fig. 19), from Cape Province, was dredged between 62 and 77 m depth.

Family **Clavelinidae**

Clavelina enormis Herdman, 1880 (p. 725), was described from a single specimen collected from Simon's Bay. Herdman's description is very short and could apply to any species of the genus. In this colony of only four zooids, two of them were united by their thoracic tunic, a feature that Herdman (1882) considered an 'abnormality'. Later, this same specimen was named *Stereoclavella enormis* by Herdman (1891) and *Chondrostachys enormis* by Hartmeyer (1909–1911). Some specimens of *Clavelina enormis* were described by Hartmeyer (1905) from Mauritius and Zanzibar, and by Millar (1956), and Monniot, C. & Monniot, F. (1976*a*) from Mozambique (Inhaca). Hartmeyer (1912) also described *Chondrostachys enormis* from Diego Garcia. All these references probably correspond to the tropical Indo-Pacific species *Clavelina moluccensis* (Sluiter, 1904) after Monniot, C. (1997: 208). A synonymy of *Clavelina steenbrasensis* Millar, 1955, and *C. enormis* remains possible.

Clavelina roseola Millar, 1955 (p. 183, fig. 13), is a species that now belongs to the genus *Stomozoa*.

Clavelina steenbrasensis Millar, 1955 (p. 185, fig. 14), known from False Bay and Mossel Bay, is a species with a colony made of lobes, each consisting of several zooids included in a common tunic.

Family **Didemnidae**

Trididemnum natalense Michaelsen, 1920*a* (p. 3). In the description of the single colony of this species, the larva is not mentioned. It seems difficult to distinguish this colony from *T. cerebriforme* without additional details.

Didemnum karlae Michaelsen, 1920*a*: 37. This species has never been recorded again since its collection in an aquarium at Isipingo. The larvae were not described and the zooids, which were not figured, have no distinctive character, so the species is hardly recognizable.

Didemnum speciosum asperum Herdman, 1886, is an Atlantic species. Sluiter (1898*a*) doubtfully assigned colonies from Durban to this species without any description. This identification cannot be retained.

Didemnum stilense Michaelsen, 1934 (p. 146), from Cape Province, was described as a cartilaginous species, thick and filled with spicules and bladder cells. The larvae were not described. Millar (1955: 176; 1962: 164) assigned to the same species didemnids from the same region that were rather different in shape with variable spicules, zooids and larva. He mentioned the possible confusion of several different species.

Didemnum velans Michaelsen, 1920*a* (p. 41). Described from Zanzibar, it was later recorded in Still Bay (Michaelsen 1934) without additional description. The species has thin colonies. The larva was not described.

Polysyncraton chuni Hartmeyer, 1912 (p. 326, pl. 43 (figs 22–23)), and *Polysyncraton spongioides* Hartmeyer, 1912 (p. 323, pl. 43 (figs 19–21)), were both collected at 318 m depth off the Cape of Good Hope and not recorded since.

Leptoclinides capensis Michaelsen, 1934 (p. 151), from Still Bay, was later recorded in the Cape Province by Millar (1962: 167) and Monniot, F. (1978) at Kerguelen. The main character of the species is the single testis vesicle.

Diplosomoides capense Hartmeyer, 1912 (p. 329, pl. 37 (fig. 4), pl. 43 (figs 15–18)), from 318 m depth off the Cape of Good Hope, may be a *Lissoclinum* species. As described it has two testis vesicles and a straight sperm duct, but the funnel-like cloacal siphon directed backwards is surprising. The species has not since been collected.

Lissoclinum cavum Millar, 1962: 168, fig. 26, from the Cape Province, was recorded with doubt from Namibia (Turon 1988) and from Madagascar (Monniot pers. obs.). This species has a rosette of testis lobes.

Family **Ascidiidae**

Ascidia arenosa Hartmeyer, 1909 (nom. nov. for *A. sabulosa* Sluiter, 1898*a*: 45, pl. 5 (figs 2–5)), was described from Durban from a single specimen. This species, covered with sand, was found again by Millar (1956) at Inhaca, Mozambique.

Ascidia compta Sluiter, 1898*a* (p. 43, pl. 5 (figs 19–21), pl. 6 (fig. 1)) was described from Knysna, from a single young specimen of 10 mm.

Ascidia krechi Michaelsen, 1904*a* (p. 253, pl. 10 (fig. 8), pl. 13 (figs 59–61)). A single specimen was dredged off Cape Town (34°33.3'S 18°21.2'E, 318 m).

Ascidia pygmaea sensu Millar, 1955 (p. 189, fig. 17) was recorded from Knysna. A small animal 1.5 mm long, not described. The figured digestive tract does not look like that of the type species figured by Michaelsen (1918: 56, fig. 9) from Mauritius. This identification seems doubtful.

Ascidia stenodes Millar, 1962 (p. 172, fig. 27) was recorded from False Bay. This species has an uncommon shape with a gut in a single loop.

Family **Agneziidae**

Agnezia capensis Millar, 1955 (p. 191, fig. 19) is known from a single specimen collected in False Bay.

Agnezia glaciata Millar, 1960 (p. 92, fig. 30B), is known from a single specimen from Table Bay. This small species (11 mm) lives free on sandy bottoms. Millar (1960), redescribing *Agnezia glaciata* Michaelsen, 1898, from Patagonia, considered *Agnezia capensis* and *A. glaciata* as synonyms. Monniot, C. & Monniot, F. (1976*b*) again recorded specimens of this species at Inhaca. The distinctions between the different *Agnezia* species have been detailed in Monniot, C. & Monniot, F. (1983).

Family **Styelidae**

Botrylloides nigrum giganteum (Pérès, 1949) was recorded by Millar (1955, 1962) from Durban Harbour, Knysna and Mozambique. *Botryllus giganteus* is distinct from *B. niger* and is known from Senegal and Brazil (Rio de Janeiro and San Sebastian harbours). This species, probably introduced into South Africa, is not present in this collection. It differs from all others by its numerous rows of stigmata (15–19), and a funnel-like stomach with a very small caecum. Unfortunately, its most original character, the position of the stomach in a prolongation of the branchial sac, was not indicated.

Alloeocarpa capensis Hartmeyer, 1912 (p. 261, pl. 38 (fig. 2), pl. 41 (figs 16–18)) was described from St Francis Bay (34°05'S 17°52'E, 267 m), and recorded by Millar (1962: 182, fig. 31) from Algoa Bay at 31 m, and off Lion's Head, Cape Peninsula at 248 m. This species is characterized by gonads on the right side only, and the ovary situated posterior to the testis.

Polyzoa falclandica Michaelsen, 1900. Hartmeyer (1912: 258, pl. 41 (figs 13–15) recorded this species from St Francis Bay. This species is considered a synonym of *Polyzoa opuntia* Lesson, 1830. Hartmeyer's description of the single specimen does not correspond to the definition of the genus. A confusion with *Alloeocarpa capensis* from the same station remains possible.

Metandrocarpa fascicularis Millar, 1962 (p. 183, fig. 32) described this species from 8 miles off Cape St. Blaize at 72 m. The characteristics of this species are discussed with regard to *M. asymmetra*.

Metandrocarpa tritonis Michaelsen, 1904*b* (p. 240, pl. 10 (fig. 2), pl. 13 (figs 55–57)) was described from Plettenberg Bay at 100 m. The only zooid collected is nevertheless like that of a colonial styelid genus. It is characterized by the presence of branchial folds and gonads made of a single testis covered by an ovary. All other species of the genus are tropical.

Oligocarpa skoogi Michaelsen, 1923*b* (p. 3, figs 1, 2). The species is known only by two specimens attached together. The external aspect is very similar to *Styela canopus*. The genus *Oligocarpa* is characterized by a single gonad on the left side; it is sometimes considered colonial but generally solitary individuals are found. Two species are known: one from South Africa, the other from Kerguelen.

Polyandrocarpa durbanensis Millar, 1952 (p. 197, fig. 25) was described from Durban. Plante & Vasseur (1966: 150, pl. 4 (figs 31–32)) recorded it from Madagascar, Tulear Harbour. The zooids are small, 6 mm, naked, and united by stolons. They have three well-formed branchial folds and a rudimentary fourth fold. Three to six gonads are aligned on the left side and 4–7 on the right side. A single endocarp lies in the gut loop.

Polyandrocarpa placenta (non Herdman) Millar, 1955 (p. 199, fig. 26) was recorded from False Bay in 28 m. In the single colony, the salmon-pink zooids are agglomerated in a common tunic. There are four branchial folds and 6–8 gonads in a line on each side.

Polycarpa (Sluiter, 1898*a*). *Styela (Polycarpa) anguinea*: Sluiter, 1898*a* (p. 52 pl. 6 (figs 15–19)) was recorded from Knysna; and *Polycarpa anguinea*: Millar, 1952 (p. 203, fig. 28) from False Bay and Knysna.

Polyandrocarpa anguinea: Millar, 1962 (p. 186) was recorded from Mossel Bay, Algoa Bay, and Mozambique. This species is said to be present in all warm seas worldwide. Generally it has aggregated individuals with an extremely brittle body wall, without endocarps. The gonads in a line on each side are suspended between the body wall and the branchial sac.

Styela (Polycarpa) natalensis Sluiter, 1898*a* (p. 50, pl. 6 (figs 11–14)) was described from Isipingo. *Polycarpa natalensis* has also been recorded by Millar (1961: 14, fig. 2) from Mozambique, and by Monniot, C. & Monniot, F. (1976*a*: 374, fig. 3B) from Inhaca, Mozambique. This small species, 5–15 mm across, differs from other South African species of *Polycarpa* by numerous endocarps distributed on the entire internal surface of the body wall.

Cnemidocarpa psammophora Millar, 1962 (p. 188, fig. 34) was described from Algoa Bay, 25–39 m. This small species is covered with sand, with tunic hairs anchoring it on the sandy bottom. It has 5–8 gonads on the left and 10–11 on the right side.

Cnemidocarpa radicata (Millar, 1962). *Styela radicata* Millar, 1962 (p. 191, fig. 35) was described from Mozambique, 2 m, and also recorded by Millar (1964: 174) from the same region. As *Cnemidocarpa radicata*, the species was also recorded by Monniot, C. & Monniot, F. (1976*a*: 368, fig. 2A) from Inhaca Island, Mozambique. The holotype is the only specimen of this species recorded in southern Africa. It has a single small endocarp on the left side of the body. The type specimen is a juvenile and the proximity of male and female gonads, which is a characteristic of the genus *Cnemidocarpa*, becomes visible in large specimens only.

Family **Pyuridae**

Boltenia africana Millar, 1962 (p. 198, fig. 40) is known from Mossel Bay and Algoa Bay in 9–22 m. This species is easy to identify, with its transverse stigmata. It is the only shallow-water species of the genus in the Southern Hemisphere.

Hartmeyeria bouilloni Monniot, C. & Monniot, F., 1976*a* (p. 390, text-fig. 5B, D, pl. 6) was described from Mozambique. This species was erroneously identified as *Microcosmus pedunculatus* Pérès, 1951, by Millar (1962: 197, fig. 39) from Mossel Bay (12 m) and Mozambique (2 m). This sandy species has a peculiar aspect with the body slightly laterally flattened, and encircled by a tunic crest extending along the dorsal and ventral line. There is a long naked peduncle arising from the middle of the ventral side.

Microcosmus albidus Michaelsen, 1904*a* (p. 213, pl. 10 (fig. 4), pl. 11 (figs 25, 26)). This species is known by a single specimen 11 × 8 mm across from 100 m depth off St Francis Bay. The gut and gonads are not figured. This species has six branchial folds.

Microcosmus trigonimus Millar, 1955 (p. 212, fig. 37). This species with eight branchial folds was only recorded from Durban; the number of specimens was not stated. The main characteristic is the presence of two gonads on the left side of the body side, one of them exterior to the intestinal loop.

Family **Molgulidae**

Eugyrioides myodes (Millar, 1962). *Eugyra myodes* Millar, 1962 (p. 206, fig. 44) was described from two specimens from Algoa Bay, in 17–18 m. This species, 11 mm in diameter, is covered with sand, has seven longitudinal branchial vessels on each side, a secondary gut loop not well marked, and obvious transverse muscles. In the genus *Eugyrioides* there is a gonad on the left side that is absent in the genus *Eugyra*.

Pareugyrioides macrentera (Millar, 1962). *Eugyra macrentera* Millar, 1962 (p. 209, fig. 45) was described from a single specimen from Algoa Bay, in 8–10 m. *Pareugyrioides macrentera* Monniot, C. & Monniot, F., 1976*a* (p. 387, figs 6B, 8) was also recorded from Inhaca Island, Mozambique. This species, covered with sand, is characterized by a long digestive tract deeply curved on itself, enclosing the left gonad. According to Millar (1962), the holotype is a juvenile with a non-fully developed branchial sac, but the larger specimen from Mozambique has the same structure, which distinguishes the species as belonging to the genus *Pareugyrioides*.

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